

Acting in Time: Transport Nurses optimising critically ill patients for transfer to a regional ECMO centre. A Grounded Theory Study.

Lyn Palmer

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ABSTRACT

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Susan Lyn Palmer

Regionalisation and centralisation of Intensive Care Units, coupled with demographic changes, have resulted in an increased demand for inter-hospital transport. The Conventional ventilatory support vs Extracorporeal membrane oxygenation for Severe Adult Respiratory Failure Trial (CESAR), validated the use of ECMO in the UK for critically ill adults. The H1N1 Influenza A epidemic in 2009, led to four more adult ECMO centres being designated, and more recently the World Health Organisation (WHO, 2020), recommended ECMO for eligible patients in the COVID-19 pandemic.

A critical incident occurred while I was undertaking the transport of a critically ill adult, which led to the unplanned use of mobile ECMO, still in its infancy. Seeking answers to the questions raised from this incident a research proposal was formed in order to investigate what could be learnt from the actions of transport nurses in promoting stability and preventing deterioration of patient acuity during the transport process.

A grounded theory approach was used to try and understand the processes and strategies that experienced transport nurses used in optimising their patients' stability and generate a substantive theory in explaining their timely actions. Under a pragmatic paradigm, this grounded theory study utilised the methods of Retrospective Medical Records Review and Interviews. Quantitative random sampling of 50 patients retrieved to a regional ECMO centre, allowed the collection of vital physiological variables staged over three time points. Data analysis showed that two out of the eight variables demonstrated a statistical significance in deterioration. Qualitative unstructured interviews from six transport nurses revealed a variety of activities, proactive and reactive, cognitive and physical, with overwhelming attention to time constraints, employed to benefit the patient.

An explanatory theory was identified. Acting in Time encapsulated extant theory from the Secure Base Model (SBM) in fostering studies, and the Actor-Network Theory (ANT), from sociological literature. Acting in Time made overt the core virtues, practices, and skills of the transport nurse in aiming to reduce the risks associated with transport of the critically ill adult while striving to maintain patient stability.

The study identified a growing need for centralisation, coordination, standardisation, audit, education and training for all those involved in transporting critically ill patients to a regional ECMO centre. It recommends that dedicated regional transport centres should be implemented for the transport of the adult critical care patient. A centralised database should be created for the import of data from the regional transport teams. Education for all nurses, not just transport nurses, needs to be available to deliver high quality care at any point of patient retrieval. A curriculum for transport education for nurses is outlined. This research reinforces and adds to the Intensive Care Society and Faculty of Intensive Care Medicine (ICS & FICM, 2019), and standards of education for nurses enhanced.

CONTENTS

<u>GLOSSARY OF TERMS</u>	12
<u>AUTHOR DECLARATION</u>	14
<u>ACKNOWLEDGEMENTS</u>	15
<u>1.0. CHAPTER ONE: INTRODUCTION</u>	16
<u>1.1. Introduction</u>	16
<u>1.2. Evolution of ECMO</u>	16
<u>1.3. Critical incident and personal reflection</u>	17
<u>1.4. The Research Question</u>	19
<u>1.5. Aims of the research</u>	20
<u>1.6. Significance of the research</u>	20
<u>1.7. Concept Clarification:</u>	21
<u>1.7.1. Optimisation of the critically ill adult</u>	22
<u>1.7.2. Transfer to a Regional ECMO Centre</u>	22
<u>1.7.3. Transport Nurse</u>	23
<u>1.7.4. Patient stability</u>	24
<u>1.8. My credibility as a researcher and a nurse</u>	24
<u>1.9. Focus of the research</u>	26
<u>1.10. Framework of the study</u>	26
<u>1.11. Outline of the study</u>	28

1.12. Chapter summary.....	29
2.0. CHAPTER 2: LITERATURE REVIEW.....	30
2.1. Introduction.....	30
2.2. Literature Strategy.....	30
2.3. Patient Journey	34
2.3.1. Transfer of the critically ill patient.....	34
2.3.2. Rationale for referral for ECMO Support.....	34
2.3.3. Decision to transfer.....	38
2.3.4. Rationale for Mobile ECMO	38
2.3.5. Pre-transfer preparation of the patient	39
2.3.6. Physiological changes during transport	40
2.3.7. Incidents occurring during transport.....	41
2.4. Retrieval Medicine	42
2.5. Roles of the Transport Nurse.....	44
2.6. Theoretical frameworks	46
2.7. Chapter Summary	51
3.0. CHAPTER 3: RESEARCH DESIGN	53
3.1. Introduction.....	53
3.2. Philosophy and research	54
3.3. Paradigms	55
3.3.1. Worldviews	55

<u>3.3.2. Epistemological Stances</u>	55
<u>3.3.3. Shared Beliefs</u>	55
<u>3.3.4. Model Examples of Research</u>	55
<u>3.4. PARADIGM OF CHOICE</u>	56
<u>3.4.1. Positivism</u>	56
<u>3.4.2. Interpretivism</u>	58
<u>3.4.3. Critical Theory</u>	60
<u>3.4.4. Pragmatism</u>	61
<u>3.5. Rationale for the research design</u>	64
<u>3.5.1. Pragmatism</u>	66
<u>3.5.2. Grounded Theory Methodology</u>	72
<u>3.6. Chapter summary</u>	77
<u>4.0. CHAPTER FOUR: STUDY DESIGN APPLIED TO METHODS</u>	78
<u>4.1. Introduction</u>	78
<u>4.2. Phase I: Medical Records Review (MRR)</u>	78
<u>4.2.1. Introduction to MRR</u>	78
<u>4.2.2. MRR method applied to this study</u>	81
<u>4.2.3. Data Collection</u>	81
<u>4.2.3.1. Data Collection tool</u>	82
<u>4.2.4. Participants</u>	86
<u>4.2.5. Data Analysis</u>	88

<u>4.2.6. Rigour in Phase I: Medical Records Review</u>	89
<u>4.2.7. Ethical approval and access to medical records data</u>	93
<u>4.3. Phase II: Grounded Theory Analysis</u>	94
<u>4.3.1. Research Setting</u>	95
<u>4.3.2. Grounded theory interviews</u>	95
<u>4.3.3 Sampling</u>	96
<u>4.3.4. Data Analysis and Coding</u>	100
<u>4.3.5. Memo Writing</u>	101
<u>4.3.6. Reflexivity</u>	101
<u>4.3.7. Assessing quality in grounded theory interviews</u>	107
<u>4.3.8. Ethical considerations</u>	109
<u>4.4. Chapter summary</u>	110
<u>5.0. CHAPTER 5: RESULTS AND DISCUSSION</u>	111
<u>5.1. Introduction</u>	111
<u>5.2. Quantitative results</u>	112
<u>5.2.1. Patient Demographics</u>	112
<u>5.2.2. Physiological profile of the Patient</u>	113
<u>5.2.2.1. Ph Results</u>	115
<u>5.2.2.2. PaO₂ levels</u>	115
<u>5.2.2.3. PaCO₂ levels</u>	116
<u>5.2.2.4. PaO₂/FiO₂ ratio</u>	117
<u>5.2.2.5. Lactate Levels</u>	118

<u>5.2.2.6. Mean Arterial Blood Pressure (MABP)</u>	119
<u>5.2.2.7. Adrenaline doses (micrograms/kilo/minute)</u>	120
<u>5.2.2.8. Noradrenaline doses (micrograms/kilo/minute)</u>	122
<u>5.2.3. Transport logistics</u>	123
<u>5.2.4. Advice given to the referring hospital</u>	124
<u>5.2.5. Interventions carried out by the transport nurses at the referring hospital</u>	126
<u>5.2.6. Interventions carried out by the transport nurse during transport back to the base hospital</u>	127
<u>5.2.7. Incidents occurring during transport</u>	128
<u>5.2.8. Summary/Discussion of Quantitative Data Results</u>	130
<u>5.3. Qualitative results: The core category: Acting in Time</u>	132
<u>5.3.1 Fostering</u>	136
<u>5.3.1.1. Anticipating Needs</u>	136
<u>5.3.1.1.1. Anticipating the needs of the patient</u>	137
<u>5.3.1.1.2. Anticipating the needs of the transport team</u>	139
<u>5.3.1.2. Engagement</u>	145
<u>5.3.1.2.1. Action on reception</u>	145
<u>5.3.1.2.2. Handover</u>	146
<u>5.3.1.3. Fit</u>	153
<u>5.3.2. Fostering in Context</u>	157
<u>5.3.2.1. The Secure Base Model</u>	159
<u>5.3.2.1.1. The Secure Base Model and its application to transport</u>	160
<u>5.3.3. Technological Moments</u>	168
<u>5.3.3.1. Mobilising</u>	169
<u>5.3.3.2. Technological Crossword</u>	172
<u>5.3.3.3. Belief in Technology</u>	175

<u>5.3.4. Technological moments in context</u>	176
<u>5.3.4.1. Actor-Network Theory</u>	177
<u>5.3.4.2. Problematisation</u>	179
<u>5.3.4.3. Interessement</u>	180
<u>5.3.4.4. Enrollment</u>	182
<u>5.3.4.5. Mobilisation</u>	183
<u>5.3.5. Acting in Time: Underpinned by SBM and ANT</u>	185
5.3.6. Discussion.....	188
<u>5.3.7. Chapter Summary</u>	192
<u>6.0. CHAPTER 6 CONCLUSION</u>	194
<u>6.1. Introduction</u>	194
<u>6.2. Precis of previous chapters</u>	194
<u>6.3. Implications for clinical practice and education</u>	194
<u>6.4. Strengths and Limitations</u>	196
<u>6.5. Recommendations for future research</u>	204
<u>6.6. Post Doctoral Research Timetable</u>	206
<u>6.7. Chapter summary</u>	207

Tables

Chapter One

1.1 Levels of Intensive Care	22
------------------------------------	----

Chapter Two

2.1. Literature search strategy using PEO model.....	32
--	----

Chapter Three

3.1. Summary of paradigms discussed.....	63
3.2. Grounded Theory approach chosen for the study.....	71

Chapter Four

4.1. Physiological Parameters collected.....	84
--	----

4.2. Experience and pseudonym of interviewees.....	99
Chapter Five	
5.1. Demographics of the sample population	112
5.2. Physiological profile of the patient over 3 time points.....	114
5.3. PH values over 3 time points.....	115
5.4. PaO ₂ values over 3 time points.....	116
5.5. PaCO ₂ values over 3 time points.....	116
5.6. PaO ₂ /FiO ₂ ratio over 3 time points.....	117
5.7. Wilcoxon paired wise for PaO ₂ /FiO ₂ ratio over 3 time points.....	117
5.8. Lactate levels over 3 time points.....	118
5.9. Wilcoxon paired wise test for lactate levels over 3 time points.....	119
5.10. MABP over 3 time points.....	120
5.11. Adrenaline levels over 3 time points.....	120
5.12. Friedman test of adrenaline levels over 3 time points.....	121
5.13. Wilcoxon signed rank test of adrenaline levels over 3 time Points	122
5.14. Noradrenaline levels over 3 time points.....	122
5.15. Transport Logistics.....	124
5.16. Advice given to the referring hospital.....	125
5.17. Number and types of interventions.....	126
5.18. Time spent at the referring hospital.....	127
5.19. Interventions.....	128
5.20. Number and types of incidents.....	129
Chapter Six	
6.1. Projection of a part time curriculum structure.....	198
6.2. Aims of the part time curriculum.....	199
6.3. Timeline of post-Doctoral research.....	207

Figures

Chapter Two.	2.1. Prisma diagram of the literature search.....	33
	2.2. Criteria for ECMO.....	35
	2.3. Trial profile of the CESAR Trial.....	36
	2.4. The Secure Base Model.....	51
Chapter Three	3.1. Dewey's Model of Inquiry.....	65
Chapter Four.	4.1. Time frame of data collection of physiological variables....	83
	4.2. Flow chart to show statistical tests.....	87
Chapter Five.	5.2. Similarities between nursing and fostering.....	156
	5.3. Similarities between foster carers and transport nurses...	157
	5.4. Secure Base Model.....	158
	5.5. Secure Base Model and Transport.....	165

References.....	210
------------------------	------------

Appendices

1. The original extracorporeal machine.....	231
2. The evolution of ECMO pre and post 2009.....	232
3. ECMO Mobile Transport Trolley.....	233
4. RAF helicopter.....	234
5. Transport hazards.....	235
6. Fixed Wing.....	236
7. Referral Pro forma.....	237
8. Transport Log.....	242
9. Data Collection Tool.....	253
10. Ethical approval.....	258
11. Example of Memo.....	260
12. Participant Information Sheet and Consent Form.....	263
13. Advice given to the referring hospitals.....	267
14. Interventions on journey back to base.....	268

GLOSSARY OF TERMS

ECMO	Extracorporeal membrane oxygenation
VV ECMO	Venous to Venous ECMO
VA ECMO	Venous to Arterial ECMO
ICU	Intensive Care Unit
Base Hospital	Patients being retrieved to the authors hospital base
MABP	Mean Arterial Blood Pressure
Pack and Wrap	Transfer and secure the patient on the trolley
CVVH	Continuous Veno-venous Haemofiltration
Conventional Retrieval	Patient returns to base hospital to receive ECMO
Mobile ECMO	Patient receives ECMO at the referring hospital and completes the journey on ECMO
Inter hospital transfer/transport	Patients being transferred/transported between hospitals
Intra hospital transfer	Patient being transferred between different departments within the same hospital
PaO ₂	Partial pressure of oxygen
PaCO ₂	Partial pressure of carbon dioxide
FiO ₂	Fraction of inspired oxygen delivered to the patient
PaO ₂ FiO ₂ ratio	A marker of acute lung injury
Inotropes	Drugs used to support blood pressure

	Adrenaline – to aid myocardial contractility Noradrenaline – to increase vasodilation
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AUTHOR DECLARATION

1. During the period of registered study in which this thesis was prepared the author has not been registered for any other academic award or qualification
2. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted
3. The programme of advanced study of which this thesis is part has consisted of
 - a. Two year period of taught modules, attendance at relevant Doctoral College training programmes and research supervision at De Montfort University
 - b. Attendance at relevant professional and research conferences
4. Guidance for the structure of this thesis was provided by the De Montfort University Guidelines Code of Practice for Research Degree students, 2018, and Research Degree and Higher Doctorate Regulations, 2019.
5. All images remain the copyright of the author. Any image not the copyright of the author has had the source referenced. All images comply with the current NMC (2018), The Code: Standards of practice and behaviour for nurses, midwives, and nursing associates.

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- To my children, who seem to think if I'm not in an ambulance I'm at the library. Thank you for being so patient and understanding.
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1.0. CHAPTER ONE: INTRODUCTION

1.1. Introduction

This research is a tale of two journeys that became intertwined, one of the researcher and the research project, and the second, the inter-hospital retrieval of a critically ill adult from a peripheral Intensive Care Unit (ICU) to a regional Extracorporeal Membrane Oxygenation (ECMO) centre. Both involve meticulous planning and preparation, utilisation of any resources available, minimisation of risks, adapting to changes, periods of reflection, and regrouping and stabilisation, in order to reach the destination as safely as possible for the benefit of all.

ECMO respiratory support can be life saving for severe respiratory failure refractory to mechanical conventional ventilation in adults (Noah et al, 2011, Ventetuolo & Muratore, 2014). It is restricted to specialised regional ECMO centres that have the appropriate resources and skills. For ICUs without this support, transferring patients to a regional ECMO centre may be the only alternative for a critically ill adult patient (Noah et al, 2011). This thesis explores this journey of the patient, with a focus on optimising patient stability throughout.

The map of these journeys will be explained in this introduction, beginning with background information about ECMO, to understand the concept for its use and the rationale for inter-hospital transport. The impetus for this thesis began with my unexpected launch into a critical incident, followed by a period of reflection, to undertake a closer look at the retrieval process. This led to the identification of the overall research question, the research aims and their significance, and the underlying framework of the study. This chapter ends with an outline of the study.

1.2. Evolution of ECMO

ECMO was founded in expanding knowledge about human anatomy and physiology, pertinently the cardiac and pulmonary circulation. Application of this knowledge to extracorporeal support arose from attempts to imitate, or replace, cardiopulmonary functions during acute illness or incident. ECMO drains the venous blood, removing carbon dioxide (CO₂), adding oxygen (O₂), through an artificial lung, before returning the blood to the circulation via a vein (Venous to Venous: VV), or an artery (Venous to Artery: VA). This is achieved through specially coated plastic tubing and the percutaneous or surgical instillation of cannulas into the patient (Annich et al, 2012). VV ECMO provides purely respiratory support, whilst VA ECMO provides both cardiac and respiratory support. ECMO can be utilised for neonates, paediatrics, and adults (Annich et al, 2012).

John and Mary Gibbon began work on the idea of extracorporeal support during cardiac surgery in the 1930's. They developed a free-standing roller pump to drive the extracorporeal circuit, but it was cumbersome and exceptionally large (Lillihei, 1993) (Appendix 1).

Advances were also being made with the artificial lung components. The breakthrough came with the synthesis of silicone rubber by Kammermeyer in 1957 and the development of a spiral coil silicone membrane oxygenator, which allowed prolonged bypass support and led to the term ECMO (Lillihei, 1993). ECMO was soon introduced for the treatment of severe but potentially reversible respiratory failure in the 1970's, initially in paediatrics but it soon became used within the adult population (Hill, et al, 1972). ECMO was commenced in the United Kingdom (UK), at Groby Road Hospital, now the Glenfield Hospital in Leicester, in 1989. The introduction of a centrifugal pump in 2009, to replace the roller pump, considerably decreased the bulk of equipment used in ECMO (Appendix 2).

Shear forces exerted on the plastic tubing by the roller pump, necessitated the availability of lengthy amounts of tubing. The centrifugal pump does not exert this force, so the length of tubing was considerably decreased. This also meant that the entire ECMO circuit could be fitted onto a normal Falcon 6 Transport Trolley to carry out mobile ECMO (Appendix 3).

The evolution from basic concept to mobile ECMO capability, coincided with the outbreak of the Influenza A (H1N1) pandemic in the UK in 2009 (DOH, 2010).

1.3. Critical incident and personal reflection

A minority of those affected by Influenza A developed rapidly progressive Adult Respiratory Distress Syndrome (ARDS), the severity of which led to some patients being supported with ECMO (Noah et al, 2011). At the time, I worked in an Adult Intensive Care Unit (AICU), primarily in an Education and Practice Development Role, but also provided part time ECMO support, and experienced in the retrieval of adult patients for ECMO. On 30th December 2009, it had snowed, and I was called to go and retrieve a young woman who had developed Influenza A post-partum and required ECMO. An experienced ECMO doctor, and I, were flown to the referring hospital via an RAF Sea -King Helicopter, the distance and weather conditions making it difficult for a retrieval by road (Appendix 4). It took 90 minutes to reach the hospital. Unfortunately, the patient had deteriorated in the time between the referral call and our arrival. Her mechanical conventional ventilation had been changed to High Frequency Oscillation Ventilation (HFOV), a mode incompatible with transport, as there were not any commercially available portable HFOV's. Six

hours were spent trying to settle the patient onto our portable ventilator with no success. She suffered a respiratory arrest, was successfully resuscitated, a chest drain inserted, and commencement of continuous veno-venous haemofiltration (CVVH). The nurses in the referring ICU and our small team worked together to stabilise and maintain the patient. It became clear that the combination of all our resources, and conventional transport equipment was not sufficient to retrieve the patient safely back to the base hospital. After consultation with the ECMO Consultant and ECMO Co-ordinator at base, we decided to put her onto ECMO at the referring hospital and transport the patient back by road. A perfusionist (to set up the ECMO circuit), and appropriate equipment, were dispatched with the aid of the NHS Ambulance Service. This was a difficult decision to make as experience with 'mobile' ECMO at this time was limited and still in its infancy, and I had no experience. I was reassured that my doctor was also a cardiac surgeon experienced in ECMO cannulation, albeit only at the base hospital. At 05.00 hrs the next morning, disconcerted that there were no chest opening kits in the hospital, but armed with orthopaedic instruments, a whole team of Accident and Emergency staff, bewildered theatre staff, and a large dose of the 'Dunkirk spirit,' we successfully put her onto ECMO. The team and the patient arrived back safely 18 hours after leaving!

This critical incident led me to consider questions such as: 'what happened'? What had happened to the patient acuity between the time of referral and arrival at the referring hospital that necessitated the requirement for mobile ECMO and in conditions that were not ideal?

On reflection there were further questions that arose regarding patient stability:

- How often did physiological changes occur?
- At what stage in the transfer process did such physiological changes occur?
- Could stability be improved and if so how?
- Had other transport nurses experienced similar critical incidents?

Exploring the incident there were further factors to be considered. For myself, I questioned what I should have, or could have done to prevent the situation. I felt vulnerable being in the situation of undertaking a mobile ECMO as I was uncertain of my role, had a lack of knowledge of theatre and theatre equipment, and lacked experience in the procedure. Was I alone in this, had other transport nurses experienced this, and if so, how did they deal with it?

I considered the impact of time within this incident, always an important consideration in the retrieval process. Whilst the mode of transport ensured that we arrived at the hospital as quickly as possible, there was then a delay due to the requirements for mobile ECMO. The wait for the mobile equipment and perfusionist was agonising as frustration with current resources grew. This highlighted the importance of appropriate timely interventions and fostered a belief in mobile ECMO. Common elements within the situation, and the friendliness, and willingness, of the retrieving hospital staff reassured belief in my knowledge and skills, but the uncommon elements left me feeling exposed. This led to further consideration of the role of the transport nurse, the multifaceted nature of which was suddenly revealed to me in this incident. I was not only there to transfer the patient safely but required to be familiar with aspects of the operating theatre and theatre nursing. What is or should be the role of transport nurses in these situations in relation to patient stability? Lastly, I felt that I had been lacking in the direct delivery of patient care and then questioned the nature of nursing in transport.

1.4. The Research Question

As with any journey the path may not be as straightforward as originally planned. The initial research question was:

'In order to optimise critically ill adults for transfer to regional ECMO centres, what can be learnt from adverse incidents of potential risk to patient stability following referral?'

When the quantitative results were analysed however, there was little evidence of adverse incidents with potential risk to patient stability. Instead, qualitative evidence demonstrated that transport nurses were proactive in maintaining patient stability and preventing deterioration. Thus, the research question was considered in light of these findings and amended to:

'In order to optimise critically ill adults for transfer to regional ECMO centres, what can be learnt from transport nurses in maintaining patient stability following referral?'

1.5. Aims of the research

To investigate the overall research question, the research aims were:

1. To critically examine the thoughts, perceptions, and influences on the actions of the transport nurse during the transfer process, from referral of the patient, preparation for the journey, and the journey itself.
2. To examine any barriers to optimisation of critically ill adults for transfer to regional ECMO centres.
3. To identify strategies to overcome any barriers in order to make any transport more of a seamless and efficacious undertaking.
4. To identify lessons learnt and make recommendations for future transport.
5. To add to national guidelines/standards in enhancing patient stability during the retrieval.

1.6. Significance of the research

Transport of the critically ill is on the increase due to regionalisation, and the increasing ease and mobility of ECMO has an impact on its availability. On review of the transport literature, there was a plethora of literature explaining 'how' to transport patients in terms of: equipment required; expertise of personnel; modes of transport; team composition, and so on. There was less focus on what happens to the patient between the referral and the arrival of the transport team, and even less on the roles, thoughts, and actions of the transport nurse in the transport process. Any new knowledge would be adding to a sparse database.

Any findings from this research would be disseminated and discussed with all ECMO centres in order to maintain and enhance the retrieval of the critically ill adult to a designated ECMO centre.

Studies showed that many of the patient care problems occurred at the hospital of origin prior to, and following the retrieval team's arrival, due to lack of preparation (Flabouris et al, 2006). This study aims to examine factors affecting preparation and identify any barriers to overcome or diminish these factors.

Advances in nursing are well documented with regards to competencies, roles and boundaries. The transport nurse however encounters a unique situation attempting to replicate an intense,

technical level of care within a moving vehicle, and then within an unfamiliar environment at the referring hospital. This research will explore the transferability of these skills, the problems or barriers that may be encountered, maintaining the balance between caring and technology, and what experience and knowledge is embedded in practice. Information obtained may be of use not only for future transport nurses, but for all involved in the transport process.

Exploring the patient journey from referral to cannulation onto ECMO becomes worthwhile when the impact of this new knowledge on transport safety, clinical skills, and practice are realised. The contributions this research study will make are:

1. The body of research-based knowledge in interhospital transfer of the critically ill adult will be expanded.
2. Professional standards in ECMO transport will be evaluated and developed.
3. To advance the role of the transport nurse through education and clinical practice.
4. For the transport nurse to maintain competence and enhance professional development.
5. Consider the multidisciplinary team approach to transport and ensuring that patient safety is at the highest standard where possible to reduce or minimise the effects of transport.
6. Ensure mortality and morbidity within this patient group is decreased.

1.7. Concept Clarification

To situate the concept of the stages of the patient journey in transferring critically ill patients to regional ECMO centres are outlined as follows:

1. Initial telephone call from referring hospital, giving details and history of the patient.
2. Consultation at the base hospital whether patient meets the ECMO criteria and whether this is a mobile ECMO or conventional transfer.
3. Assembling transport crew, equipment, and ambulance to deploy transport team.
4. Either: Arrival at referring hospital to move onto a conventional trolley and return to the base hospital for consideration of ECMO or cannulate onto ECMO at referring hospital and bring back to base on ECMO.

1.7.1. Optimisation of the critically ill adult.

A universal definition of a critically ill patient does not exist. However, most hospitals use the classification of Levels of Intensive Care (Table 1.1), adopted from '*Comprehensive Critical Care*' (DOH, 2000).

Table 1.1. Levels of Intensive Care (DOH, 2000).	
Level 0	Patients whose needs can be met through normal ward care in an acute hospital
Level 1	Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the Critical Care team
Level 2	Patients requiring more detailed observation or intervention including support for a single failing organ system or post-operative care and those 'stepping down' from higher levels of care
Level 3	Patients requiring advanced respiratory support alone, (Includes mechanical ventilation or requiring ECMO) or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure

This research focuses only on Level 3 patients. Optimisation of the patient commences at the time of the initial referral through: advice given to the referring hospital; appropriate equipment and skill for transfer; preparation of patient prior to transport team arriving; and preparation for return journey with the patient. The facility to resuscitate and stabilise the patient should be provided by the acute hospitals (ICS & FICM, 2019).

1.7.2. Transfer to a Regional ECMO Centre

Until the H1N1 pandemic of 2009, there was only one adult ECMO centre in the UK. The Department of Health then published a best practice guideline '*The Management of Severe Refractory Hypoxia in Critical Care in the UK in 2010*' (DOH, 2010), and designated four more respiratory adult ECMO centres. March 2020 saw the coronavirus (a global pandemic) reach the UK where the five centres participated in receiving patients for ECMO (NHS, 2020). Although the

numbers have yet to be published a number will have been transported to these regional centres. Transfer to a regional ECMO centre may involve a variety of distances and modes of transport. Previous transport guidelines had been published only by the Intensive Care Society (ICS, 2011). The ICS and the Faculty of Intensive Care Medicine (FICM), came together to publish their '*Guidance on: The Transfer Of The Critically Ill Adult*', (ICS & FICM, 2019). Regarding methods of retrieval the best practice at the base research hospital is that: for a transfer journey time of up to 2 hours (or up to 150 miles), a road ambulance is used; and for a transfer over 2 hours (or over 150 miles), a helicopter or a fixed wing aircraft is utilised if available. Each mode of transport has benefits and limitations. Road ambulances can be subject to flat tyres, breakdowns, and accidents (Appendix 5).

The provision of a helicopter pad enables an efficient team departure, however there is no guarantee how close the helicopter can get to the referring hospital. Helicopters often land on football fields, parks or farmland. They are noisy, cramped, and availability is subject to weather conditions

The fixed wing option is the fastest, but delays occur as the process involves unloading and loading several times on and off the aircraft at both destinations. Additionally, road ambulance transport must be provided between the airfield and the hospital, also space can be limited in the aircraft (Appendix 6).

1.7.3. Transport Nurse

A transport nurse in this study, has an ICU qualification, undergone transport training, and a period of supervision in order to be deemed competent in all modes of transport, fulfilling the ICS & FICM standards (2019). They undertake the responsibilities of checking and packing the correct equipment, with the technical knowledge of how it works. They take handover at the referring centre, assess the patient, and then safely help the patient onto the transport trolley if a conventional transport, or transport the patient to theatre, and aid the theatre team in cannulation of the patient. Patient safety is paramount as the transport nurse ensures that there are enough drugs, fluids, and correct equipment for the journey back to base. Documentation of this process is also the domain of the transport nurse. At the core of all this activity they also must maintain the professional virtues integral to the role of the nurse.

1.7.4. Patient stability

Retrieval can have an adverse effect on the patient exacerbated by their critical illness. Optimisation in preparing the patient for the transfer is important but maintaining stability through:

continual assessment and monitoring; acting on vital signs through interventions; correction and prevention of further deterioration; and providing safety and comfort contribute to patient stability. Knowledge and experience of transport of the critically ill patient contributes to patient stability

1.8. My credibility as a researcher and a nurse

Credibility entails giving evidence in relation to the social and professional location of the researcher with regard to the study in order to assess factors such as professionalism, methodological competence, and intellectual rigor (Flick, 2009).

I came into nursing after undertaking a Bachelor of Science (BSc) (Honours) in Sociology and Social Research Methods, the research component of which comprised of quantitatively analysing telephone responses for the provision of disability access at Dental practices. During my nursing career I have also undertaken a further BSc (Honours) in Intensive Care Nursing which included the NMC Specialist Practitioner Qualification (SPQ), and a Master's degree in Behavioural Biology. The thesis for my Master's degree was a study comparing eccrine sweat gland activity as a measure of pain, to the timings of the use of the Patient Controlled Analgesia (PCA) Pumps, and verbal ratings of pain. This was again a quantitative approach. I also undertook research into nursing and doctors' activities during the era of 'The New Deal' (NHS, 1991), to explore the advancement of nursing roles in the reduction of doctor's working hours. I thought I had a good background in research when I came into the taught research component of the Doctor of Health Sciences (DHSci), programme. That assumption was immediately exploded when I encountered the world of qualitative research, of rich description, of seeking to understand phenomenon, instead of merely counting and documenting. I realized that particularly in regard to my Master's thesis how this could have been enriched by asking the participants to describe and explain their thoughts, feelings and actions with regard to pain. The drive to undertake academic work has always been to improve nursing practice and improve patient care, and I realized that I had not considered fully all aspects of the involved nature of nursing practice. An aspect I intended to redress in future research.

I am a clinically skilled expert nurse with over 37 years of experience, the last twenty being spent in Intensive Care. The ICU is an environment rich in technology that has increased over time ranging from: electronic monitoring; infusion pumps; organ support equipment; diagnostic aids; and latterly electronic documentation. The traditional nursing role has evolved in expansion of knowledge and skills to adapt to these changes in medical science and meet the challenges of the 21st Century. With each new addition of equipment, ICU nurses undertake competency-based education, training,

and skill acquisition, including transport training. With the exception of the Advanced Nurse Practitioners (ANP's), autonomy has not been achieved and the medical hierarchy, and decision making, still dominates in Intensive Care. As an ICU nurse the exposure over time to certain groups of patients promotes what Benner (1984), describes as 'intuition' on the progression through experiential learning to become an expert nurse. Frustration occurs when medical clinical decisions do not take account of your ability to acknowledge your: clinical and caring expert knowledge; clinical reasoning in transition; and clinical forethought (Benner et al, 1999). I was also aware of debates in nursing literature concerning the relationship between the use of technology in ITU as a potential barrier to patient focused care (Sandelowski, 1997, Barnard & Sandelowski, 2001, Barnard, 2002). Inevitably in this era technology and nursing are inexorably linked. Whilst some argue for the negative influence that technology has on caring values and nursing practice (Almerud et al, 2008, Price, 2013), other researchers demonstrate an increased safety of care delivery, and a reduced workload allowing more direct patient contact (Price, 2013). Debates continue but technology is an integral component of the Intensive Care environment reflected in the skills and competencies of the ICU nurse.

I have always tried to maintain professional and compassionate care to the best of my ability using the resources that I have. The critical incident propelled my desire to obtain knowledge as to whether patient deterioration was a singular or more common occurrence. I wanted to explore the transport process itself to identify where and when measures could be taken to optimise or maintain the patient. I wanted to gain further insight into the role of the transport nurse, their thoughts, their actions or reactions, and any synergy between technology and delivery of care. I joined the permanent ECMO team prior to the start of this research in order to not only observe, but to participate in the entirety of the transport process. This meant involvement with the initial referral, communicating with the referring hospital, the ECMO multidisciplinary team, the transport team, and receiving the patient at the base hospital i.e. from start to completion. The overall aim was to gain knowledge to benefit patient care.

1.9. Focus of the research

This study focuses on events before and during inter-hospital transport. It aims to capture data on changes experienced by the patient, and the thoughts and feelings of the transport nurse only during this time period. It does not focus on advocating the use of any particular equipment or resources, but rather the complex interplay of roles. It will only look at critically ill adults, being

transported to a base hospital. Although it involves a multidisciplinary team of doctors, occasionally surgeons, anaesthetists, and perfusionists, where applicable, the role and scope of the transport nurse will remain the focus.

1.10. Framework of the study

The background framework upon which an ECMO centre functions is underpinned by the CESAR Trial, (CESAR: conventional ventilatory support vs extracorporeal membrane oxygenation for severe adult respiratory failure), conducted by Peek et al (2009), as an accepted modality of treatment for ARDS. The Extra Corporeal Life Support Registry (ELSO), provides information and support to ECMO centres in terms of advice, publications, policies, and research-based evidence. The Department of Health 'Comprehensive Critical Care' (2010), listed several recommendations regarding the transfer of critically ill adults, incorporated by the Intensive Care Society (ICS), in their 2011 standards and guidelines, and later in the ICS & FICM guidelines in 2019.

Nurses have a unique role in society, striving to maintain professional and compassionate care in the face of economic, geographical, political, demographic, and scientific changes (NHS England, 2016). In ICU this role has been challenged by the debates concerning the dominance of technology over the caring role (Sandelowski, 1997, Barnard & Sandelowski, 2001). The central role of any nurse is to care, and this ethic remains the core value despite the influence of time and change up to the present day:

'caring is the essence of nursing, caring for, caring with, and caring about' (Stewart, 1929, p1)

'Registered nurses play a vital role in providing, leading and coordinating care that is compassionate, evidence-based, and person-centred' (NMC, 2018, p2)

A foreground framework was required that reflected adaptation to the challenges of the 21st century, but also highlighted the central values of nurses. One approach to illuminating the core values of nursing, is by examining the practice of nursing. This approach was developed by Sellman (2000), through adopting the definition of practice propounded by MacIntyre (1985). He defined a practice as:

'any coherent and complex form of socially established cooperative human activity, through which goods internal to that form of activity are realised in the course of trying to achieve the standards of excellence which are appropriate to, and partly definitive of, that form of activity' (MacIntyre, 1985, p187).

For MacIntyre, the main thrust of a practice lies in striving for high standards within the activity, and thus accessing the internal goods to those jointly engaged in the practice. Sellman (2000), explains that the altruistic nature of nurses, in aiming for high standards of patient care ensures the delivery of internal satisfaction for the nurse in improving care outcomes. The pursuit of delivering excellence in care outweighs external goods such as high rates of monetary rewards (Sellman 2000). The internal goods are however only of value to the individual undertaking the practice and are also contextual as to when and where the practice is being undertaken (Sellman, 2000). Nursing itself is a professional practice and as such requires a commitment to the care of an individual or a group of individuals (Sellman, 2000). This quest in maintaining and enhancing nursing practice, and the realisation of internal goods does require certain virtues which have specific purposes in helping to maintain the practice. The notion of a virtue itself attracts philosophical, ethical, moral, and pragmatic debates (Sellman, 2011). A virtue may be generally assumed to be a characteristic or general disposition that leads a person to act in a certain way consistent with that virtue, historically and culturally guided, and nurtured by socialisation, education, and moral and ethical guidance (Sellman, 2011). However, as Kupperman acknowledges, there are situations or occupations within which 'normal actions' or practices may differ from previously acceptable behaviour (Kupperman, 2001, p 246). This point is often applied to nursing where a nurse encounters an unfamiliar world for which experience of everyday acceptable (moral) behaviour provides insufficient preparation for the difficult ethical issues that can arise in healthcare practice (Kupperman, 2001). These dilemmas then are dealt with by nurses with what Sellman (2011), terms *professional virtues*, that is, ordinary virtues that are well developed and provide guidance for nursing practice. He states that there is not a substantive difference between ordinary and professional virtues, but that the latter are more of an extension created to meet the challenging of nursing in a demanding and changing healthcare system (Sellman, 2011). The acquisition of these professional virtues allows nurses to adapt different roles at different times to meet these demands. He does also note that the expression of a professional virtue in an individual does not mean that they necessarily demonstrate this virtue when not engaged in professional work (Sellman, 2011). One example of a professional virtue

particularly applied to nursing is what Aristotle (384–322 BC), calls *Phronesis* often translated as ‘practical wisdom’. He summed this up as being the capacity to know when to do the right thing for the right person in the right way and at the right time (Aristotle, 1953). In more modern times this application of both practical and theoretical knowledge is also the key in the transition of a novice nurse to an expert nurse (Benner, 1984), the demonstration of which highlights the stages of this transition.

The advantage of viewing nursing practice in a MacIntyrean sense is that it can be used identify the virtues or attributes integral in nursing practice. Identification of the virtues in professional nursing practice becomes important in the context of the constraints of the 21st Century, the societal, demographic, and technological demands, which requires the nurse to adapt and specialise in order to meet the changing needs of the population (Sellman, 2000). Using the MacIntyrean approach to explore the nursing practices of transport nurses will shed light on whether these core values are demonstrated and their relationship with the technology utilised by transport nurses.

1.11. Outline of the study

Chapter 2 the literature review, uses the PEO model to examine the literature concerning inter hospital transport. It follows the patient journey through: referral; optimisation; physiological changes during transport; incidents, and retrieval medicine. Exploration of the nurses’ involvement with transport is also reviewed, and the theoretical concepts of the Secure Base Model (SBM), and Actor-Network Theory are discussed.

Chapter 3 introduces the philosophical underpinning of the study that informs the data collection and analysis. Four paradigms are outlined and the rationale for the selection of pragmatism is shown. The methodology pertaining to the study, that of grounded theory is then discussed.

Chapter 4 puts forward the study design as applied to method utilising two phases; Phase I, a retrospective Medical Records Review, and Phase II, Unstructured interviews, both phases under the methodology of grounded theory. Data collection and analysis are presented, reflexivity acknowledged, rigour in both discussed and ethical considerations outlined.

Chapter 5 presents the integration of the findings and the discussion. The essence of grounded theory is that data, data analysis, and the generation of theory are inextricably linked, the explanatory theory being derived from the iterative analytical strategies of immersion and engagement with the data.

Chapter 6 the conclusive chapter to the thesis, begins with a precis of previous chapters, looks at the implications for nursing practice, and strengths and limitations of the study. Educational requirements are discussed and recommendations for future research and publication are made.

1.12. Chapter summary

This chapter has provided a tale of two journeys to give an overview of the research topic, together with the justification for and the significance of the study. The focus and framework of the study were briefly outlined. The next chapter critically reviews the evidence and literature pertaining to inter-hospital transport of adult critically ill patients transported for ECMO.

2.0. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The literature review provides an indication of the current knowledge and work in the field under review and gives specificity and a contextual background to the study. It is used to discuss whether current research findings apply to the optimisation and stability of the critically ill during transport and identify whether there is a need to pursue further study in this arena. The aim of the chapter is to highlight the importance and significance of the research question for all those involved in the transport process.

The chapter commences with an outline of the literature strategy used for the literature review. The stages of the patient journey from referral to transport back to the receiving hospital are used to map the second part of the literature review:

- Transfer of the critically ill patient
- Rationale for referral for ECMO
- Decision to transfer
- Rationale for mobile ECMO
- Pre –transfer preparation
- Physiological changes during transport
- Incidents occurring during transport

The third section looks at the development of retrieval medicine /lessons learnt specialty of transport. A focus on any literature pertaining to transport nurses comprises the fourth section. Following this, two theoretical frameworks: the Secure Base Model (SBM), and the Actor-Network Theory (ANT) are reviewed. This is followed by a summary of the chapter.

2.2. Literature Strategy

Within nursing and health sciences the focus is upon providing evidence-based practice to aid and validate clinical decision making. The foundation for providing evidence-based practice relies upon the collection and assembly of the best available knowledge, from which to review and evaluate, clinically significant and transferable evidence to clinical practice.

The process of obtaining this evidence begins with the literature search, or strategy, that encompasses clinical problems. One systematic and applicable method used within the clinical arena, is the PICO model, used within National Institute for Clinical Excellence '*The Guidelines Manual*' NICE, 2014), and advocated by nurse researchers (Bettany-Saltikov, 2012). In brief, the mnemonic stands for:

- P - Patient, problem, or population that is going to be studied.
- I – Intervention, treatment or action, being considered.
- C - Comparison – to what other action (intervention or treatment) are we comparing the considered action.
- - Outcome – what do we anticipate as the outcome.

Although widely used, PICO appears to be more relevant for quantitative research in testing a hypothesis that does not necessarily exist in qualitative research (Bettany-Saltikov, 2012). This factor lead to the consideration of using an alternative, the PEO model (Bettany-Saltikov, 2012):

- P - Patient, population and their problems.
- E - Exposure
- O - Outcomes or themes

Thus, the search strategy enacted using the PEO model is shown in Table 2.1.

Table 2.1. Literature search strategy using the PEO model (Bettany-Saltikov, 2012)			
PEO Elements	Key Words	Search Terms	Search Strategies
Patient/Population and their problems	Critically ill adults	Critically Ill	Critically ill OR Acutely ill OR Intensive Care OR Critical Care
Exposure	Transfer to regional ECMO centre	Transport/transfer	Transport OR Transfer OR Retrieval OR Interhospital transport OR Interfacility transport OR ECMO transport OR Mobile ECMO
Outcome or Themes	Stability in transport Optimisation during transport		Stable/Unstable OR Deterioration OR Preparation for transport OR Physiological variables OR Incidents in Transport OR Optimising patients for transport AND/OR Transport Nurses

The literature strategy comprised an in-depth analysis of the published literature pertaining to inter-hospital transport and ECMO including: textbooks; journal articles; national and international guidelines and policies. Database searches included AMED, EMBASE, HMIC, MEDLINE, BNI, CINAHL and ProQuest, and reference lists from relevant publications were reviewed. Combination of the key search words led to refining to information specific to the research area. In total 1,285 articles were initially obtained, and the search was refined further by excluding emergency and trauma transport. Paediatric literature was considered if recommendations could be applied to the adult critical care population. Articles pertaining to ECMO and ECMO transport were found to include both cardiac and respiratory use. The articles on cardiac ECMO were then further excluded from the study. The PRISMA flow diagram (Figure 2.1), depicts the flow of information through the different phases of the literature review, the number of records identified, the screening, eligibility for inclusion and exclusion, and reasons for exclusions (Moher et al, 2009).

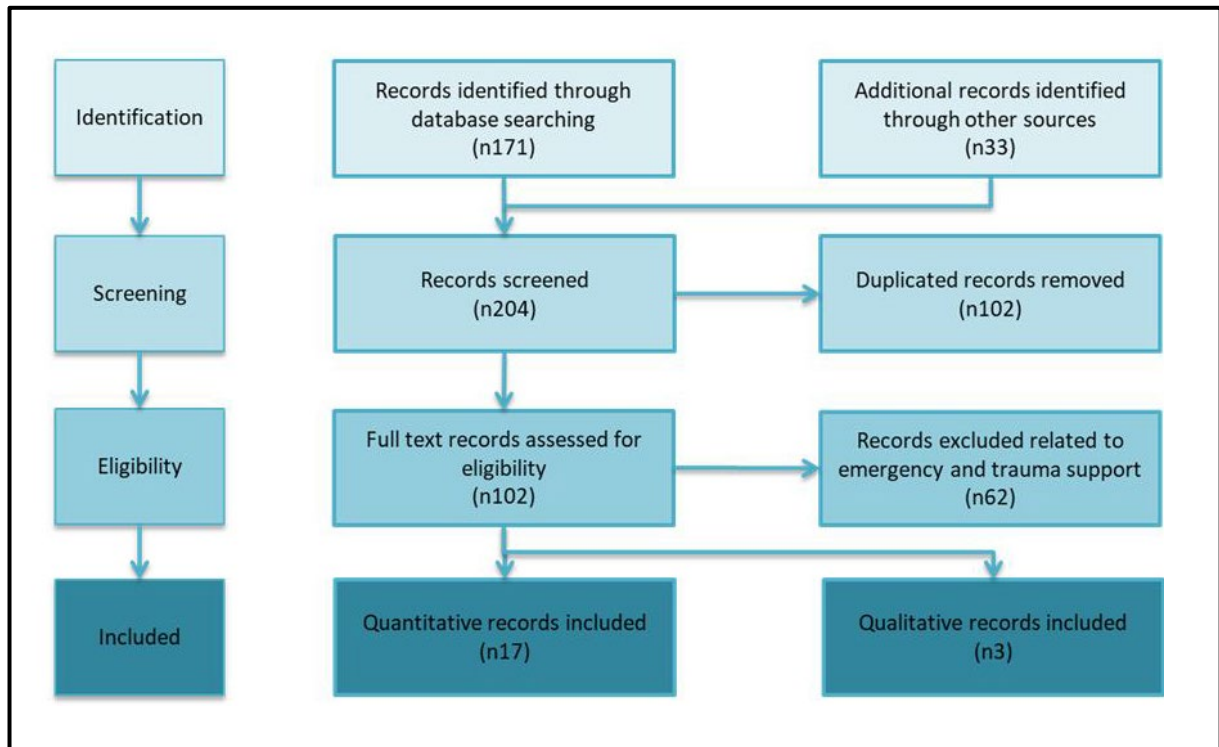


Figure 2.1 Prisma diagram of the literature search

2.3. Patient Journey

2.3.1: Transfer of the critically ill patient

Transfer of critically ill patients occurs worldwide, even in underdeveloped countries. The rationale behind the transfer can be access to an ICU where geography has driven the need for inter-hospital transport, as in rural parts of Australia, (Beckmann et al, 2004), New Zealand, America, Europe (Roch et al, 2014), and India. Centralisation of specialised diagnostic and advanced treatment modalities also makes inter-hospital transfer an integral part of the healthcare system (Roch et al, 2014, Lindskov et al, 2013, Wagner et al, 2013). In the United Kingdom (UK), regionalisation, relative lack of intensive bed availability, and complexity of the healthcare system has led to an increase in the number of critically ill patients moved between hospitals (Bellingan et al, 2000), estimated at over 11,000 in 1997 (Brummell, 2014). This estimated number has not been updated and is still quoted in transport literature. Lack of definition of 'critically ill' and a lack of a national reporting system in the UK, hinders the provision of current accurate data (ICS & FICM, 2019). However, regionalisation does improve patient outcomes, by centralising resources and skills (Lyphout et al, 2018). Regionalisation also impacted the newly designated ECMO centres (DOH, 2010), as they are expected to have a dedicated transport team and the potential to undertake mobile ECMO.

2.3.2. Rationale for referral for ECMO Support

The majority of patients referred for respiratory ECMO are diagnosed with acute respiratory failure (Noah et al, 2011). For critically ill patients, mechanical ventilation is a lifesaving modality, but this can lead to Ventilator Induced Lung Injury (VILI) (Han et al, 2005), with associated multi organ failure, leading to a decrease in survival for patients with Acute Respiratory Distress Syndrome (ARDS). Mortality and morbidity for patients with ARDS remains high at 30 – 50% (Peek et al, 2009, Noah et al, 2011). Iatrogenic factors such as high airway pressures, large tidal volumes, and high level of inspired oxygen concentrations (FiO_2), via mechanical ventilation contributes to a high mortality rate (Rossaint et al, 1997, Combes & Ranieri, 2015). Strategies to prevent VILI such as: ventilation modes giving lower peak airway pressures and tidal volumes (Combes & Ranieri, 2015); avoidance of fluid overload; prone positioning; acceptance of higher $PaCO_2$ levels; Nitric Oxide inhalation; and HFOV may be tried (Rossaint et al, 1997, Brodie &

Guérin, 2015). Despite all these measures, pulmonary gas exchange in some groups of patients fail to improve, and the physician may refer for ECMO support. Figure 2.2. shows the criteria for ECMO:

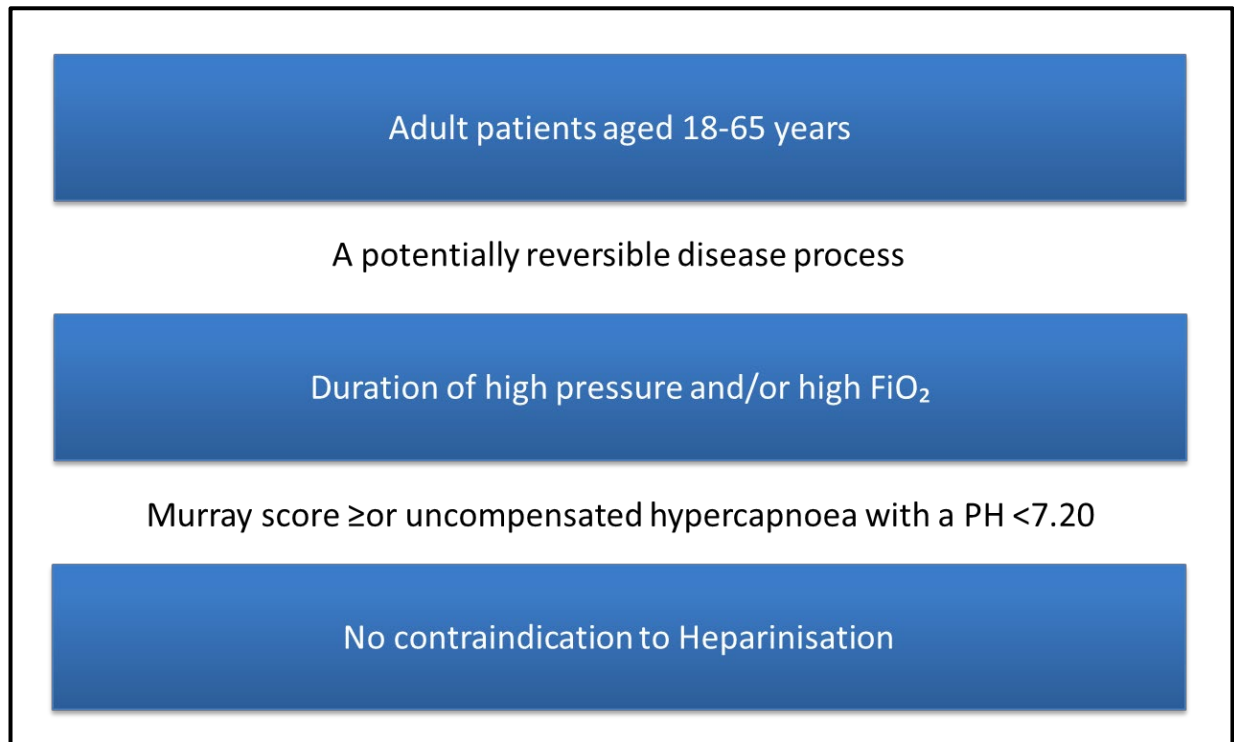


Figure 2.2. Criteria for ECMO

ECMO has been an advocate for the treatment of patients in severe but reversible ARDS (Rossaint et al, 1997, Ciapetti et al, 2011). In light of the increasing success with ECMO, the medical community sought randomized controlled trial (RCT) evidence of the benefits of ECMO over standard therapies. The first adult RCT was conducted by Zapol et al, in 1979, in America, comparing (VA) ECMO to standard therapy for severe respiratory failure. The study demonstrated poor survival of approximately 10% in both groups and delayed adoption of ECMO in the adult population for some time. There were faults inherent in the study: the degree of severity of illness for the study entry criteria; lack of experience with ECMO; and the choice of VA ECMO for patients requiring only respiratory support (Peek et al, 2009). In the second RCT by Morris and colleagues in 1994, patients were randomised to either: extracorporeal CO₂ removal with VA support; or standard therapy utilising a computer programme for ventilator management. This study showed no difference in outcomes but highlighted the lack of experience in ECMO in some of the study centres, and high blood loss in

the VA patients (Peek et al, 2009). The third RCT, was conducted at the Glenfield Adult Intensive Care Unit (AICU) in Leicester UK, called the CESAR Trial (Conventional ventilation or ECMO for Severe Respiratory failure). This study utilised the advantage of regionalisation, and the VV approach in respiratory failure (Figure 2.3)

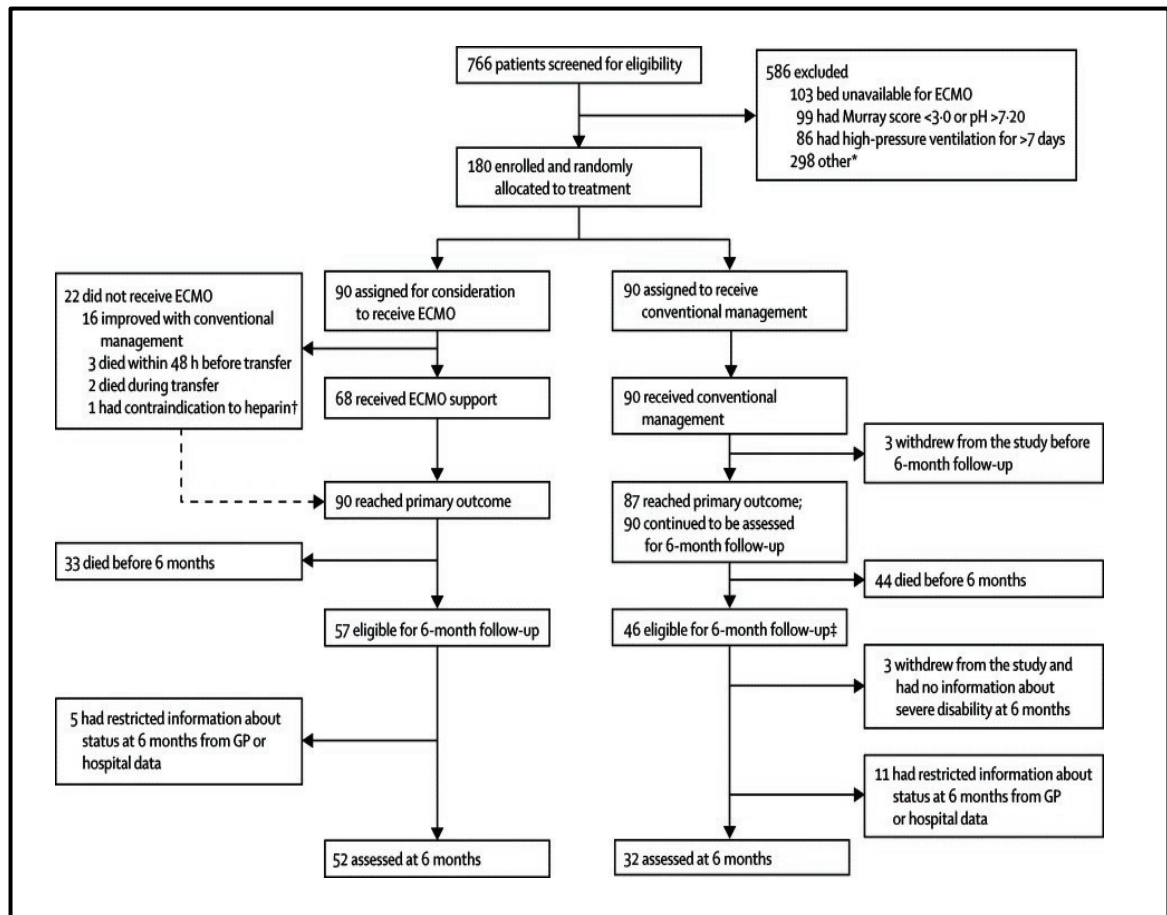


Figure 2.3. Trial profile of the CESAR Trial (Peek et al, 2009).

In total, 760 patients were screened in the UK from 68 centres, although 586 were excluded, due to: no ECMO bed available; not fitting ECMO criteria; or logistics concerning consent. The trial randomly assigned 180 adults in a 1:1 ratio to: receive continued conventional management at a standard treatment centre; or referral and transfer to an ECMO centre. In the ECMO arm of the trial 68 out of 90 (75%), patients received ECMO support. The overall outcome showed that 63% (57/90), patients allocated to consideration for treatment by ECMO survived to 6 months without disability, compared to 47% (41/87), of those allocated for conventional management (Peek et al, 2009). The major criticism of the trial was the lack of standardisation and control over the therapies

used in the conventional treatment centres such as: lung protective strategies, which could have affected the outcomes independently. However, it did establish ECMO as a viable intervention in patients with ARDS. A British collaborative cohort series of pandemic H1N1 induced ARDS, also showed lower mortality (23.7% for ECMO referred patients versus 52.2% for non ECMO referral patients), after propensity matching for 80 patients transferred to ECMO referral centres (Noah, 2011). Many centres in the world use ECMO technology and have reported survival rates in excess of 50% in uncontrolled observational studies of patient outcomes from ARDS: Javidfar et al, 1992 (53%); Rossaint et al, 1997 (73%); Lindén et al, 2001 (72%); Wagner et al, 2008 (67%); Haneya et al, 2009 (56%); Hokby-Lundgren et al, 2011 (74%); Forrest et al, 2011(86%); Noah et al, 2011 (76%); Lindskov et al, 2013 (71%); Rupperecht et al, 2013 (75%); Michaels et al, 2013 (H1N1 60%); Luyt et al, 2010 (86%); Bryner et al, 2014 (62%); and Kanji et al, 2016,(66%).

Much of the data cited is from single centre audits, and case series, which are thought to provide the weakest level of evidence, such that their validity and wider applicability should be interpreted with caution. The exception is Kanji et al (2016), which is a multi-centre study.

Comparison between studies presents difficulties surrounding factors such as: time; sample size; technology used; and missing data. The study from Bryner and colleagues in 2014, was a summary of 20 years' experience, whilst Lazzeri et al (2018) reported on an eight-year experience. There were differing numbers in the sample population from large (n = 124, Lindskov et al, 2013), to small (n = 1, Knapik et al, 2011), dependent upon the size and case mix of the ECMO centre. Earlier studies such as Javidfar et al, 1992, may show lower survival rates as technology and knowledge has led to a more refined use of ECMO, and less ECMO related complications (Dalton, 2011).

Any literature review on ECMO, and transport in general, needs to acknowledge the fact that there is data missing, the hidden mortality as termed by Boedy et al (1990). These are those patients not referred for either ECMO, or transport. Similar to other studies (Bellingan et al, 2000, Gebremichael et al, 2000, and Uusaro et al, 2002), there is a lack of data regarding the outcome of patients not receiving ECMO, making generalisations of risk/ benefit outcomes difficult. Many ECMO centres report survival rates based on the number of patients receiving ECMO, but not on the total referrals, a point which needs to be considered when discussing ECMO survival.

Overall then the literature shows the global embeddedness of ECMO as a respiratory adjunct for critically ill adults in respiratory extremis.

2.3.3. Decision to transfer

Any transport imposes a risk of increasing mortality and morbidity (Durairaj et al, 2003, Golestanian et al, 2007, Marx et al, 1998). Critically ill patients by nature have deranged or altered physiology, requiring organ support and invasive monitoring. Any movement: onto the transport trolley; the forces of acceleration and deceleration; noise; vibration; and changes in temperature, are not tolerated as well as the less sick patient (Martin 2009). The literature therefore advises that early referral, and early transport to an ECMO centre, is the key to minimise mortality and morbidity. Rossaint et al (1997), observed that inter-hospital transfer of severely hypoxaemic patients may be associated with cerebral hypoxia and death, and it is preferable to transport patients to the ECMO centre even before the admission criteria is reached. Ciapetti et al, (2011), found a rapid progression of respiratory failure in the H1N1 population, and recommended that transfer to a referral centre should be undertaken before they become too unstable for conventional retrieval. In a study by Knapik et al in 2011, also following the H1N1 pandemic, there were an increased number of patients with severe cases of ARDs who fulfilled the ECMO criteria, but due to late referral were not suitable for transportation, and nine patients died whilst awaiting evaluation in the study by Rupprecht et al, (2013). Severity of the patient's respiratory insufficiency often makes transportation without ECMO support unsafe (Mendes et al, 2017). Cianchi and colleagues carried out an evaluation at the referring hospital by optimizing ventilator therapy and fibroscopy assessment. If deemed unsafe, ECMO cannulation occurred at the referring hospital (Cianchi et al, 2011).

2.3.4. Rationale for Mobile ECMO

Mobile ECMO has been standard practice in some countries since the start of the 1990's as evidenced from studies in: America (Bryner et al, 2014); Germany (Rossaint et al, 1997, Rupprecht et al,); Sweden (Lindskov et al, 2013, Hokby-Lundgren 2011); and more recently: Australia (Forrest et al, 2011); Italy (Ciapetti et al, 2011); France (Luyt et al, 2010, Desebbe et al, 2013); Poland (Nitsch & Kalenka, 2011), and the United Kingdom (Robinson et al, 2013, Sherren et al, 2015). This practice has been driven and sustained by advances in technology leading to smaller, more portable ECMO units (Nitsch and Kalenka, 2011), and a more percutaneous and less surgical approach (Baldwin et al, 2011). When comparing outcomes of mobile ECMO versus conventional transport (Huang et al, 2016), found no significant difference in APACHE II score, Murray Score, and Oxygenation Index, between the two groups, before transportation. On arrival those in the ECMO group had lower Heart Rate, Respiratory Rate, FiO₂, and PIP and Murray score. They observed that

mobile ECMO is safer than conventional transfer, but it needs to be implemented by an experienced team, however this was only a small study (n = 5 on ECMO, and 6 on conventional). Other studies covering large geographical area have adopted mobile ECMO as the only way to safely transfer critically ill patients (Rossaint et al, 1997, Roch et al, 2014, Forrest et al, 2011). Mendes et al, 2017, utilised a single centre experience and a systematic review of published data regarding complications and mortality with ECMO transportation. There was a 68% survival rate and concluded that mobile ECMO transport seemed to be safe.

2.3.5. Pre-transfer preparation of the patient

Once the patient has been accepted for ECMO there is a period of time before the retrieval team arrive, and pretransfer stabilisation advice is often given by the ECMO centre (Cianchi et al, 2018). Correction of physiological instability prior to transport reduces the severity of critical incidents (Flabouris et al, 2006). A retrospective study of 100 consecutive inter-hospital transfers, by Ligtenberg et al (2005), found that 70% of events were due to poor patient preparation, and that in 50% of the transports, pre stabilisation advice was ignored.

A longer time spent in preparation for transfer appears to be associated with a shorter length of ICU stay (Belway et al, 2006). However, data pertaining to pre-transfer preparation, can arise from only a small number of records (Belway et al, 2006), and so generalisability may be questioned. In addition, some literature did not give a definition, or examples of pre-transfer preparation (Flabouris et al, 2006). Guidelines from the ICS & FICM, state that the patient should be appropriately resuscitated and stabilised prior to transfer, to reduce the physiological disturbance associated with movement and the risk of deterioration (ICS & FICM, 2019). The time taken for this to occur needs to be balanced against immediate transfer for life saving treatment. These guidelines also give examples and advice as to what pre-transfer preparation entails (ICS & FICM, 2019). Of note, they also acknowledge that much of the available published evidence relating to transfers arises from small observational studies and case series, including audit. These are considered to be of the lowest quality of evidence according to a grading system of evidence by Jaeschke et al, in 2008. The ICS & FICM (2019), propose that incorporating expert clinical advice with this evidence, advances it to 'strong' on the grading system used. Borrows et al, 2010, advocated the referring hospital undertake vital interventions, and goal directed therapy pre-transfer, but recognised that this may be influenced by resources, staff, and skill mix. Their solution is that a specialised transport team, acting as an extension of the base hospital, brings with them unique specialist skills and

expertise that can be employed at the bedside to initiate advanced care otherwise not available (Borrows et al, 2010).

Comparisons between studies present difficulties therefore due to lack of a baseline of patient acuity at time of referral, identifying advice and requested interventions; definition of stabilisation; and differences in skill mix and resources at different referring hospitals. Strauch and colleagues (2017), acknowledged that there were no evidence-based criteria on which to judge the quality of different inter-hospital transport systems. They devised a Quality of Interhospital (QUIT) Critical Care transport system, together with a measure of changes in the patient's physiological condition (EMR), 24 hours post transport via a web-based application. They aim to provide a multi centred evaluation and audit, to assess the effects of the different modes of transport, together with a database that can be accessed for research and improve clinical practice. The results of this study to date has still not been published. Centralisation, and co-ordination of transport in the UK for the adult population, is lacking, and therefore data pertaining to the logistics of transport and patient demographics are not available so the results of the QUIT EMR study could be an impetus for improvement.

2.3.6. Physiological changes during transport

There are very few studies documenting changes in physiological parameters in detail. Ligtenberg et al, 2005, in their prospective audit of 100 consecutive transfers took note of: Blood pressure (BP); Heart Rate (HR); arterial blood gas values; lactic acid levels; Blood sugar readings; ventilation settings; inotropic/vasopressor drug doses; and the presence of venous or arterial catheters. The time points for recording were on departure of the transport team and on arrival back at the base hospital. They implemented a pre-defined threshold, above which the patient was deemed to have worsened. Overall, 37% had increased number of vital variables beyond pre-defined thresholds after transport, 34% had an equal number; and 29% had a lower number. Although this indicated that some patients showed significant deterioration, the parameters did not reach statistical significance.

Other studies collected parameters at various timepoints to gauge effects of using a specialist retrieval team (Bellingan et al, 2000, Wiegersma et al, 2011), or to evaluate the safety of mobile ECMO (Rossaint et al, 1997). Forrest et al, 2011, recorded physiological parameters from referral to outcome, to reflect on their experience of a mobile ECMO retrieval programme, necessitated by geographical access and regionalisation. They studied 40 patients from 2007 – 2010, requiring ECMO initiation at the referring centre and subsequent transfer. The data collection was retrospective and included demographic details along with pre-defined co-morbidities. The severity

of illness prior to ECMO was established by the severity of: hypoxaemia; hypercapnia; acidosis; level of ventilatory support; inotropic support; Murray score (stratifies lung injury); and SOFA (Sequential Organ Failure Assessment) scores. Retrieval data was collected from the referring hospital, the retrieval team, and the receiving hospital. The duration of the ECMO run, complications of ECMO and outcome were also recorded. The patient characteristics included: aetiology of the respiratory failure; echocardiography findings; inotropes and /or vasopressors use; respiratory and ventilator parameters; patient positioning; and use of inhaled nitric oxide. This was repeated 24 hours post ECMO. Timings during retrieval were documented including time from referral to establishment, transport time from referring hospital, total duration of retrieval, and the number and type of complications during retrieval. The results show a high rate of survival to discharge (86%) in adults with severe ARDS. Part of their success they attribute to the fact that all the referring hospitals have an ECMO retrieval system in situ, comprising ECMO equipment, retrieval and management protocols. This was a well organised and in-depth study that collected a lot of data that could be used for a variety of purposes in the future. They also questioned the New South Wales ECMO admission criteria for some patients and felt that the Murray Score and PaCO₂ parameters needed tightening up. There was no control group due to ethical factors, but information on the declined referrals might have addressed this deficit. Caution is needed to interpret any data regarding changes in patient status over time, the number of interventions required, or events noted, as these can occur simply because of the natural course of the patient's illness (van Lieshout et al, 2016).

2.3.7. Incidents occurring during transport

Transport involves a risk – benefit balance, regardless of whether the patient is being transferred for ECMO. Valentine & Schwebel (2016), describe risk as the probability that an adverse event will occur. The main body of evidence surrounding adverse events relies on case series, cohort studies, and prospective data (Beckmann et al, 2004, Fan et al 2006, Wiegersma et al, 2011, Lyphout et al, 2018). The actual percentage of occurrence varies from 3-75% due to differing methods and definitions (Droogh et al, 2012). A systematic review carried out by Fan and colleagues in 2006, looked at inter-hospital outcomes of adult patient transport, and from 5 studies, a total of 245 adverse incidents were reviewed. They found a paucity of studies examining adverse incidents during inter-hospital transport but note that this might be due to the fact that they focused on case series. In common with Flabouris et al, 2006, they note: a lack of standard definition, or grade of adverse events; lack of standardised documentation; and under reporting.

Flabouris, Runciman, and Leving in 2006, obtained data from 125 incident reports, showing 272 incidents from 4 retrieval teams. Equipment incidents rated the highest percentage of incidents recorded (37%), followed by patient care (26%), transport operations (11%), interpersonal communication (9%), planning or preparation (9%), retrieval staff (7%), and tasking (2%). Limitations of the study highlighted that the data relied on the willingness of the transport team to complete incident reports, and again lack of standardised definition. However, the classification of events showed the multifactorial nature of adverse events, relating to both technical, and human error. Droogh et al (2012), looked at 353 patient transfers, and 55 technical problems were encountered, whilst Ligtenberg et al, (2005), evaluated 100 consecutive transfers, and found that adverse events were recorded in 34 %, and of these 30% were technical, whilst 70% impacted on patient care.

The definition of 'technical' in these studies pertains to equipment malfunction, equipment safety, inexperience of use, and inadequate equipment preparation. Technology has advanced over time, so decreasing the risk of equipment malfunction requires adherence to clear documentation, training, and checking of equipment (Ligtenberg et al, 2005, Droogh et al, 2012, Lyphout et al, 2018).

The lack of definition of an adverse event also makes comparisons between literature exceedingly difficult. Similarly, the term 'human error' is ambiguous, as this could relate to lack of skills (Ligtenberg, 2005); teamwork (Flabouris et al, 2006); and communication (Wiegersma et al, 2011). Lyphout et al, in 2018 noted that communication incidents result not only in frustration and inefficiency, but also have a significant impact on patient care, thus extending the work of Ligtenberg et al (2005). Mueller et al (2020), recommends clear allocation of responsibilities, and centralisation of information. The study by Lyphout et al (2018), was conducted over 15 months, in two ICU's and 688 patients' retrievals. Although limited by self-reporting, they did note that patient safety incidents were reported in 16.7% of transports, with 3.7% associated with healthcare associated harm. They noted that this was lower than previously recorded in the literature, although lack of standardisation makes comparison difficult. They recommend that standardisation, clear communication, and the use of checklists may minimise the risk of adverse events. Further literature comments on the impact of specialised retrieval teams in promoting safety and aiding patient stability.

2.4. Retrieval Medicine

This idea of a specialised, highly skilled and expert retrieval team to assess, stabilise and then transfer the patient is what Shirley & Hearn (2006), describe as the specialty of 'retrieval medicine'. It is recommended that set standards should be adhered to in well trained and experienced staff;

appropriate equipment and monitoring; and checklists (Wiegersma et al, 2011, Droogh et al, 2012, Blakeman & Branson, 2013, ICS & FICM, 2019). Gebremichael and colleagues (2000), undertook a retrospective evaluation of 2 years' experience of transporting 39 critically ill patients, and the impact of patient stabilisation, by using an experienced retrieval team with a fully equipped ground ambulance, thus providing a mobile intensive care unit. Results showed a more refined transfer, and decreased the risk of mortality, although it is hard to distinguish whether it was the resources or skills that were more effective. Bellingan, et al, in 2000, found that of 259 transfers of critically ill patients (168 by a retrieval team, and 91 by the referring hospital), there was considerably more acidosis, hypotension, and early mortality in the group transferred by a non-specialist team. Specialist versus non-specialist teams are therefore shown to be of benefit. Vaja et al, (2015), adds that transportation of mobile ECMO patients was safe, thanks to a well-trained dedicated ECMO mobile team. Outcomes are difficult to evaluate as specialized team activities in the referring hospital sometimes initiate specialized care unavailable at the referring centre (Belway et al, 2006). The importance of checklists pre departure with regard to availability and safety of equipment has also been found to be important (Vaja et al, 2015).

Using standardised equipment, to ensure staff familiarity and enhance safety is recommended (Flabouris, Runciman, and Leving, 2006, Vaja et al, 2015). Despite the guidelines from the ICS (2011), and later ICS & FICM (2019), on the key elements of transport, there appears to be little evidence of central or local co-ordination of adult retrieval teams and even less in the provision of adequate training for this role (Andrews et al, 2008, Brummell, 2014). Brummell (2014), observes that 0.2% – 6.6 % of transfers results in an adverse event, so it is surprising that the responsibility is often given to a junior doctor, and few have attended any training. This is contrary to the guidelines (ICS & FICM, 2019), that staff need to be competently, trained in order to undertake the transfer safely. There appears in the UK to be a dearth of structured training (Andrews et al, 2008). The Advanced Life Support Group in 2002 developed the Safe Transfer and Retrieval (STaR), programme to meet this shortcoming, which Andrews et al, 2008, adopted to improve their own in-house competency retrieval team, as well as team debriefings from adverse incidents. They advocate that regionalisation of services should apply to: local co-ordination and provision of training and adherence to local and national guidelines; to achieve regulation in uniform standards of transport care and skills; and national reporting of adverse incidents and 'near misses' to enable the provision of further education, training and resources.

Composition of retrieval teams can vary, and previous medical and nursing roles are blurred with some Advanced Nurse Practitioners (ANP) on the retrieval teams undertaking previously medical roles (Mackintosh, 2006). Comparison between teams' effectiveness is therefore limited. Lyphout et al (2018), compared nurse led to doctor led transport, with the number of incidents being the defining difference. Doctor led transfers showed significantly higher rates of patient safety incidents (29.1% v 10.8%), and healthcare associated harm (8.5% v 1.7%). Factors affecting this are not explained, though further study through the exploration of the nurses' role and responsibilities in transport, may provide clarity in this area.

2.5. Roles of the Transport Nurse

There were very few studies addressing the role and responsibilities of the transport nurse that did not include a precis of equipment and technical issues. Gustafsson, et al (2010), used a critical incident technique, to explore and describe the transport nurses' cause of worries and concerns during transport. Data was collected from one central hospital and two county hospitals, and a total of 30 nurse specialists in: anaesthesia; intensive care; and preoperative care, were interviewed. Overall, the results showed that worries and concerns revolved around two main areas: being unable to influence their work situation; and unable to carry out their tasks as expected. These included: safety issues during hospital transport; not having clear guidelines; being unable to use the necessary equipment and being unable to provide adequate care for the patient (Gustafsson et al, 2010).

Resolution, or strategies the nurses employed were: managing through internal resources of thinking through to create an overview of the situation beforehand; self-preparation; preparation of equipment; and preparation of the patient. Copying previous colleagues' actions in a similar situation, relying on prior knowledge and experience, and sharing these experiences, also aided them. External sources were applying instructions from the doctor; following prescriptions, and existing work instructions. They preferred working with familiar colleagues, asked for additional resources, and transferred responsibilities to other groups of staff (Gustafsson et al, 2010). Use of these strategies alleviated their expressed worries and concerns.

Although enlightening there are limitations in the study. The nurses were specialists in different areas so could not bring a generic skill set to the transport. Although training was provided, they also encountered different types of patients, thus not allowing them to build up experiential knowledge in one type of patient. The use of different ambulances with different configurations were used, so

familiarity in both the location of equipment and the environment was decreased. These factors individually could give rise to cause and concerns, as well as the lack of generalisability between nurses. In relation to these limitations the employment of the strategies they used can be appreciated.

Brewer and Ryan-Wenger (2009), undertook a descriptive and phenomenological study within the Critical Care Air Transport Team (CCATT). They used a range of methods: unstructured interviews; focus groups; narratives; group interviews; participant observation; and in-flight documentation, to identify the knowledge and skills required for critically ill patients in a combat situation. They identified ten dimensions of deployment experience of the CCATT nurses. Clinical competence was identified as the ability to perform, alone if necessary, with a range of clinical skills for a variety of critically ill patients, including paediatrics. Operational competence referred to the ability to utilise portable equipment in an environment where there were few, or no, back up resources. Soldier and survival skills and personal and physical readiness were the third and fourth dimension. Psychosocial readiness refers to the ability to display a mental and emotional attitude of confidence and success. The dimension of leadership incorporated being able to both guide and manage self and others and make decisions under pressure. Administrative concerns encompassed maintaining structure and discipline in the patient care process. Incorporating the goals and values of the CCATT team was the seventh dimension. Maintaining the structure and discipline necessary to the functioning and wellbeing of the patient was the next dimension. The last dimension was familiarity with Aircraft, Air and Evacuation procedures (Brewer and Ryan Wenger, 2009). The aim of the study was to provide information to CCATT trainers and unit personnel, in order to evaluate CCATT nurse's readiness for future deployment. In total 33 participants were included, but not all of them were nurses, they included physicians and respiratory therapists. The rationale was that CCATT nurses do not work in isolation and therefore others were invited to share their perspectives on the nurses' role. While labour intensive, and costly, this is the major flaw identified with this study. It does not reflect the individual nurses' readiness for future deployment as it is inextricably linked to perceptions by other team members. Demographics of the sample population were also withheld due to confidentiality reasons. Therefore, it is impossible to generalize to other transport studies.

A study by Senften and Engström (2013), described through qualitative thematic analysis, seven critical care nurses' (CCN) experience of nursing critically ill patients during helicopter transfer. One theme arose from the findings: safe nursing care, but sometimes feeling afraid. This arose from identification of limited space in which to work; and noise detracting from good communication.

Patient safety was optimised through careful planning and checking, utilising the resources of team members, and teamwork. They stated a dilemma in whether to allow relatives to accompany the patient, but applied safety factors and patient acuity, in making the decision. They also ensured that the relatives were looked after if not allowed in the helicopter. Risks exist in connection to any transport and the CNN's were aware of the additional risks of bad weather and darkness. To diminish this fear, they relied on the competence of the pilots, and focused on the patient and patient care. They managed patient fears by communication, touch and reassurance, but occasionally required the use of sedation. The study was limited by the fact that out of 13 CNN's, seven responded, whom the researcher's felt wanted to talk about their experience. They were unaware of why the other five did not participate, or whether this would have influenced their findings.

Each of the qualitative studies show limitations, but they demonstrate that research does exist with regard to nurses, transport and critically ill patients.

Considerable interest in the process of inter-hospital transport exists as evidenced by the large number of publications in the literature. However, despite this interest, there is a dearth of rigorous, adequately powered studies, comparing commonly used categories in this setting, and even less focus on the transport nurse.

2.6. Theoretical frameworks

The literature review shows the rationale for the use of ECMO, and mobile ECMO in response to the acuity of critical respiratory failure and in decreasing the risk of transport. Studies monitoring the physiological changes occurring in patients, recommended pre-transfer preparation dependent upon skills and resources available. Incidents occurring in transport were noted to be both technical and human in nature (Droogh et al, 2012). This was reinforced by the qualitative reviews highlighted by transport nurses themselves, with an emphasis on not only preparation and knowledge of equipment, but self-preparation through planning, teamwork, and communication (Senften & Engström, 2013). Recommendations were made that by maximising the interaction of resources and skills through dedicated transport teams, and standardised equipment, this would lead to improvements in the safety of patient transport. The literature review made overt the multifactorial nature of transport, and the transport process, and the co dependence of equipment, procedures, safety checks, protocols, with that of medical staff, neither could effect a transport without each other. It is a fact that the use of health technology has increased significantly over the last few decades with point of care devices, electronic records, information and communication technology (ICT), and

in ICU (Booth et al, 2016). This had led to research into the impact of the effectiveness of this technology upon the nursing role and the impact on patient care. The literature review highlights gaps in the overall understanding of how nurses interact with this technology, agreed by Cross & McDonald (2013), and overall consideration of the evaluation of human-technology relationships within complex healthcare environments (van Gemert-Pijnen et al, 2011).

One limitation to this perspective has been in the choice of conceptual lens through which the interaction between humans and technology are explored (Booth et al, 2016). An omnipresent view of technology as having power over humans has been outlined by researchers exploring relationships between nursing, caring, and technology (O’Keefe McCarthy, 2009, Yeo, 2014). Others have taken on socially driven mantles to describe human-technology relationships, such as the Technology Acceptance Model (Kowitlawakul, 2011, Strudwick, 2015), which states that an end users *intention* to use technology can actually be a predictor of actual technology use. This approach has been criticised by Bagozzi (2007), as socially deterministic in its view of human agency determining the behaviours in human-technology relationships.

Recognition of valuing both social and technical factors in technological use drove nursing researchers to explore the interactions between nurses and technology. Gough et al, 2014, advocated exploring relationships *between* nurses, their work, and technology, exploring factors such as: which technologies; whose hands; where; and what effects, were important in consideration of the theoretical dualism between touch and technology. This increase in the sociomaterial view of nursing practice has led to researchers using a sociotechnical lens in this arena.

One such approach is that of the Actor-Network Theory (ANT), a theoretical framework that can be used in approaching the complexity of the transport process and the actions of the transport nurse, to trace interactions encompassing all these facets of equipment, planning, checking, teamwork, and capture the panorama of the transport process. An approach which would cede equality and symmetry to the effects of the human and non-human co dependence phenomenon that occurs in transport. ANT was originally conceived in the 1980s in science and technology studies by Bruno Latour, John Law, and Michael Callon. Although there has been internal changes within the authors regarding the original philosophy of ANT as a ‘theory’, it has become known as a useful tool or approach in exploring, and making overt the insights into the dynamics and objects of apparently everyday processes, in revealing discrete ambivalences, multiple overlapping worlds, complex interactions and contradictions, that are embedded in the transport process. In a way to draw sense

and draw nearer to a phenomenon. As with any approach ANT has its own limitations that make it more amenable to some questions rather than others. ANT helps us to oversee this panorama as a messy organisation, yet able to uncover the networks behind this seemingly disorganised process. It provides a conceptual framework for the empirical analysis of the organising process (Latour, 2004b, 2005), and a call for close empirical study of associations.

As a starting point ANT considers the symmetry of both humans and non-humans as equal and that distinctions between the social and the natural, between the material and the cultural, the human and the non-human and between the technical and the social, are taken to be effects rather than foundational assumptions (Fenwick & Edwards, 2011).

The phrase *actor* is used to denote both human and non-human entities which are able to perform action (Sheehan, 2011). The capacity to act is not an inherent property of the actor, but rather activated through relationships with other actors (Booth et al, 2016), and potentially effect processes (Whittle & Spicer, 2008). Organising and assembling actors together enable networks between these separate actors to become established, in order to mutually support and accomplish tasks or action, like a retrieval. Determination of the agency and importance of individual actors is established through a process of mutual negotiation and increasing alignment within a network to form reciprocal and common interests. This process is called 'translation'. Latour (2005, p 6), describes ANT as the 'sociology of translations'. A stable network is established when the actors align and perform in unison, this is called a 'blackbox', and recognised when the network appears to function as a seamless individual unit rather than multiple components (Booth et al, 2016).

Analysing the process of translation, following and tracing associations, demonstrates how any new relations are created, where connections have been made, any reconciliation involved, and strategies or steps taken to ensure continuity (Sakari, 2006). The use of ANT in following the paths of agency, associations, negotiation, reciprocity, the interdependence and utilisation of human and non-human actors within the transport process, should produce detailed descriptions that would enlighten understanding and appreciation of the multifactorial nature of retrieval medicine. Transport nurses know what they do, and ANT offers an insight into not only what they do, but how and why they do it (Latour, 2005), the gap identified in the literature review.

The non-privileging of human over non-human actors does not equate to non-importance of human actors but rather as a means to a deeper understanding of their world. Gadd (2016) in her research on street children's lives, emphasised gaining knowledge of *their* view of street life, and came to

show how they manipulate actor-networks to reach their life goals through either acquiring or rejecting other actors, identifying the most important actors from the children's' perspective. Use of ANT within this research will not only show the connections, interactions, and networks comprised of human and non-human actors, but also position the research to describe the transport nurses' actions from *their* point of view in the transport process.

The main criticism of ANT lies in its inability to be applied as a rigid framework that subjugates theory, method and life under observation. Latour (2005), in describing the evolution of ANT after its original inception, regrets the choice of the terminology actor-network theory, and advocates that although it has transitioned from being not being a theory of the social, but rather a theory of space and fluids, within a more complex modern struggle to define a theory of society. Others have criticised ANT as possessing limited ability to facilitate the explanation or prediction of phenomena (Elder-Vass, 2008, Cresswell et al, 2011). In the face of criticism, Desai et al, 2017, advise that ANT should be considered as a range of methods to describe the connections that link human and non-humans (e.g, objects, things, technologies, policies, ideas), and that combining other theoretical perspectives with ANT may be useful in minimising this inherent weakness.

The Secure Base Model (SBM) was adopted within this research as a theoretical framework to complement ANT. Whilst the latter demonstrates the ability of actors to form a network through negotiation, connections, and ultimate translation, SBM offers a way to explain and show the techniques and skills used by the transport nurses to influence, and be influenced by other actors in manipulating and fostering the engagement and disengagement of connections at appropriate times.

The Secure Base Model was developed by Beek and Schofield (2004). It is based on Bowlby's 1969 attachment theory (Bowlby, 1969), the aim being to provide a secure base from which a securely attached infant over time will feel safe enough to move away from. Over time attachments form as the care giver is physically, emotionally and mentally available, to meet the needs of the child. A secure base is formed, which gives the child confidence to explore the environment. Beek and Schofield, (2004) applied this concept to looking at foster carer approaches to parenting. The model can also be used to assess potential foster carers and used as a framework for foster care training and practice. The secure base theory proposes 5 dimensions of caregiving, all of which overlap and aid in providing a secure base. The dimensions are:

- Availability
- Sensitivity
- Acceptance
- Co-operation
- Family membership.

A foster carer must demonstrate the qualities of being: physically and emotionally available to foster trust; possess sensitivity and reflection, to help manage feelings, be able to adapt to the differing needs of the child; to be non-judgemental in acceptance, to foster self-esteem; to be able to negotiate and co-operate, to empower the child; and lastly promote family membership with the child (Figure 2.5).

The Secure Base Model and its focus on the five dimensions makes clear the qualities required to be an efficient and effective caregiver in providing a secure base. This model is applied to incorporate and explain the qualities described in the transport nurses' narratives that show that fostering of these elements in the SBM lead to the black box utopia of a seamless and united transport retrieval. Conceived in 2014, there has been very little time to implement and evaluate this model, or indeed its transition into other contexts apart from fostering. However, one study by Biggart et al, 2017, proposed using the SBM in the context of the emotional demands made upon social workers, and that developing a secure base would aid emotional regulation and resilience for them. Using thematic analysis from 52 telephone interviews with Child and Family Social Workers, they found that across the five dimensions of the SBM, the supervisors and teams did provide a work-related secure base. They propose that in the future reflection on beliefs and behaviours of supervisors and team members will aid in providing a model of a secure base for teams. This study will add to the sparse research in the application of the SBM in other work contexts.

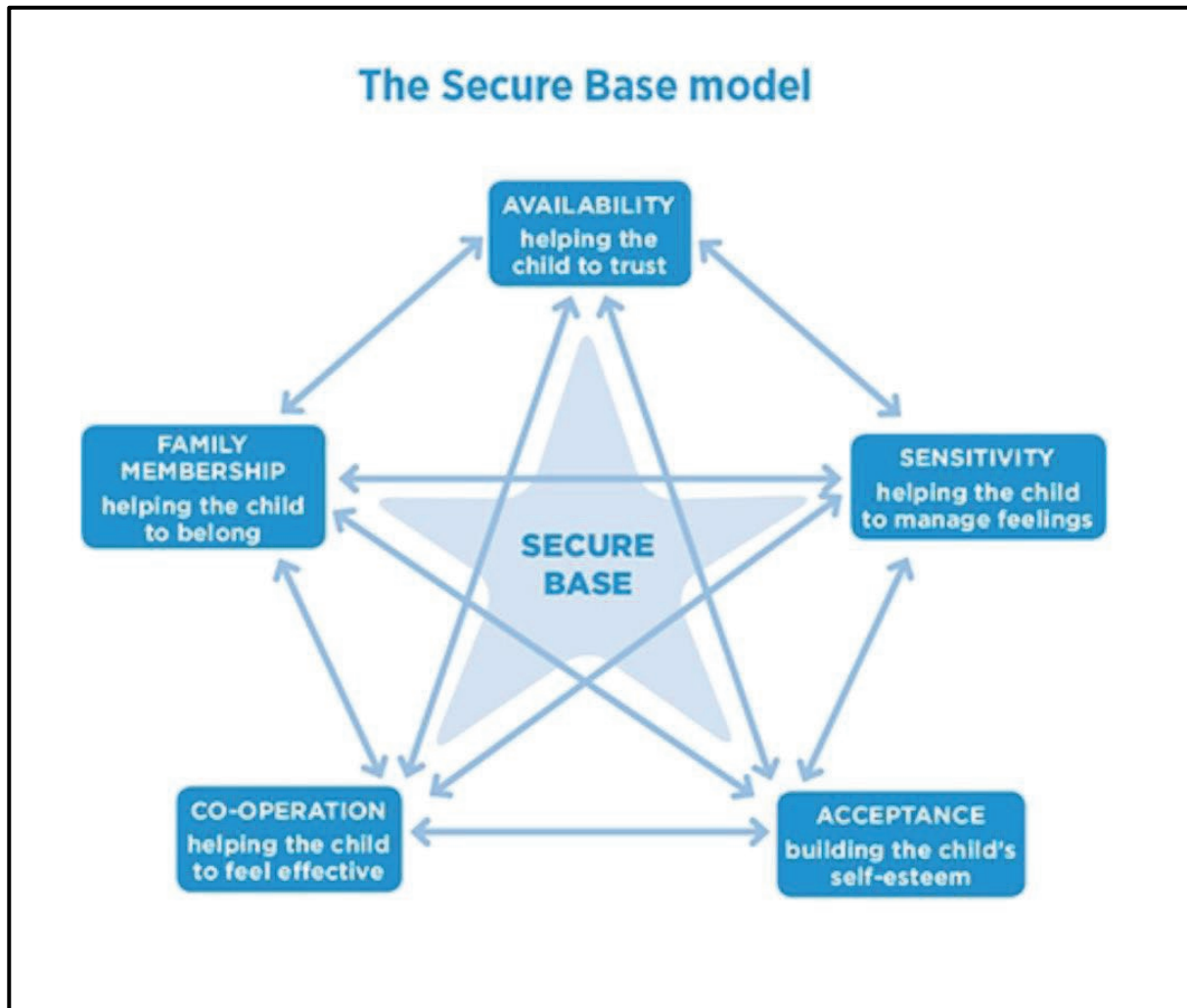


Figure 2.4. The Secure Base Model (Providing a Secure Base, Gillian Schofield and Mary Beek, University of East Anglia, Norwich, UK).

2.7. Chapter Summary

The aim of this chapter was to align the significance of the research question in relation to the literature obtained. The literature review looked at the rationale for inter-hospital transport, the progress towards mobile ECMO, and associated risk factors. Lack of standardization limited comparisons between studies. Scoring systems were found to be inadequate in predicting the possibility of patient deterioration during transport, and deterioration over time was not found to be significant. The use of specialised retrieval teams and mobile intensive care units was advocated along with mobile ECMO. Pre- transfer stabilisation was recommended through the application of

retrieval medicine. The use of mobile ECMO is advocated in order to stabilise the patient for transfer to ECMO particularly over long distances.

The lack of evidence of significant deterioration of the critically ill adult during transport aims to be addressed by this study. There was a lack of studies applying evidence to pre-transfer preparation and stabilisation of patients for retrieval. The evidence seems to suggest however that compliance with existing guidelines is poor and that concerns over the standards of many transfers remain. This may reflect the difficulty of performing high quality research in the transfer setting. The quantitative and qualitative tools in this study will look at pre-transfer preparation advised and assess the level of preparation encountered. Actions taken to proactively or reactively, optimise and maintain patient stability have not been made overt, this will be addressed in this study. The role of the transport nurse, their actions in optimising and maintaining patient stability, whilst retaining their core values of being a nurse, has also not been addressed. Employing the theoretical frameworks of both ANT and SBM will add clarity and illumination to these deficits.

The next chapter describes the philosophy underpinning the study and its application to data collection and analysis. Pragmatism, the use of Medical Records Review data, and grounded theory analysis are shown.

3.0. CHAPTER 3: RESEARCH DESIGN

“Would you tell me please, which way I ought to go from here?” asked Alice.

‘That depends a good deal on where you want to get to’ said the cat”.

Lewis Carroll (1865, p.55), *Alice’s Adventures in Wonderland*

3.1. Introduction

Since Florence Nightingale, nursing has been concerned with acquiring theoretical knowledge, driven by a need to establish itself as a professional discipline, and balance the art and science debate. It wanted to demonstrate validity through the establishment of a scientific research base (Weaver & Olsen, 2006). This drive resulted in a plethora of nursing research existing in many forms and stances, resulting from factors such as: developing a specialised nursing knowledge base; differentiating itself from medical models of care, whilst responding to changing societal needs. Common to all these approaches was the overall aim to improve patient care by delivering the best available practice. What was not common was their ability to make explicit any underlying philosophy, without which any research credibility is in jeopardy. Philosophy offers a framework that does not constrain, but rather provides common agreement, and an arena in which to ponder and debate fundamental beliefs, to gain understanding and realisation from which to innovate and create credible research.

My prior research had comprised of survey and empirical methods of data collection. A belief was instilled that pure science (deductive and logical), was the only way to obtain knowledge. Completion of a two-year taught component for a Doctorate in Health Science was the catalyst in experiencing different concepts about the nature of knowledge, perceptions of reality, and the methods and tools used to make them overt.

The aim of this chapter is to illustrate the path to the study design and the underlying philosophical basis informing the research study, namely the pragmatic paradigm, and the mixed methods approach of retrospective survey data and grounded theory analysis.

3.2. Philosophy and research

The Ancient Greek word φιλοσοφία (*philosophia*), thought to be coined by Pythagoras, literally means 'love of wisdom' or 'friend of wisdom' (Grayling, 1982). This 'love of wisdom' is inherent throughout all the sciences including nursing science, and the link between science and philosophy needs to be made overt as Dennett states:

'There is no such thing as philosophy-free science; there is only science whose philosophical baggage is taken on board without examination' (Dennett, 1996, p21)

Philosophy relies on a rational examination when thinking about fundamental beliefs and assumptions about the nature of truth; reality; and the world. These beliefs are created by: social and contextual understanding; the justification of belief or theory of knowledge; and the methods used to obtain this knowledge (Grayling, 1982). Research per se, is an inherent theoretical perspective that provides a link with the research question, to a particular method(s) used to investigate the phenomenon, and is the result of these beliefs about the theory and foundation of knowledge and the nature of reality, in order to gain 'truth' (Hesse-Biber, 2010). The methodologies are derived from a researcher's own assumptions or beliefs about the nature of reality (*ontology*), and philosophy of the nature of knowledge and knowledge building (*epistemology*) (Hesse-Biber, 2010). The acquisition of new knowledge is therefore obtained from a particular philosophical viewpoint or stance (Flick, 2009). In research there is, an inherent group of assumptions, a set of basic beliefs or theoretical positions, encompassing both theoretical and philosophical foundations, loosely termed 'paradigms' (Flick, 2009). These are now examined in more detail in order to explain the justification for the paradigm under which this research is based.

3.3. Paradigms

Thomas Kuhn (1922 – 1996), introduced the term '*paradigm*' to summarise a group of assumptions, or researcher's beliefs, in an effort to create knowledge (Morgan, 2007). Subsequent criticism of his work about the clarity of the definition, led to him later changing the term to 'disciplinary matrix' (Kuhn, 1970). The original word though became adopted, and is commonly used within academic work, in particular social science (Morgan, 2007). According to Morgan there are four basic versions of the paradigm concept ranging from general to specific. Common to them all is an acknowledgement of a shared belief system, which effects the kinds of knowledge sought, and influences subsequent interpretation of the data. They differ in the degree of their generality. The

four versions are identified as: world views; epistemological stances; shared beliefs; and model examples.

3.3.1. Worldviews

Paradigms can be perceived as representing all encompassing worldviews regarding ways of experiencing and thinking about the world including values, morals, ideas and shared understandings (Morgan 2007). This is a popular representation of the term paradigm often used in social sciences (Flick, 2009). It influences researchers in their preferences as to what and how they study (Morgan, 2007). The concept does not specify the elements contained within the worldview, nor does it allow more than one 'worldview' at a time.

3.3.2. Epistemological Stances

Paradigms as epistemological stances allows a closer look at issues concerning the nature of knowledge and knowing. Different belief systems influence how research questions are asked and answered (Morgan 2007). This concept has become more dominant in social sciences with discussions abounding as to the possibility of merging of different epistemological stances (Tashakkori and Teddlie, 2003), i.e. a mixed methods approach. One criticism according to Morgan (2007), is that it does little to inform decisions as to what to study, and how to do so.

3.3.3. Shared Beliefs

Paradigms as shared beliefs amongst members of the same community, gives rise to a consensus amongst what to ask, and the methods most appropriate for answering those questions (Morgan 2007). Kuhn preferred this version (Kuhn, 1970), emphasizing the specific beliefs and practices that could be shared within a community of researchers within the practice of a specific specialty. A side effect is that it allows: the possibility of a shift in beliefs, a 'paradigm shift' (Kuhn,1974); the utilisation of more than one set of research methods; particularly in relation to societal and technical evolution, and the possibility of the creation of a new paradigm altogether.

3.3.4. Model Examples of Research

In this concept, paradigms serve as a template or examples for conducting research within a given field (Morgan, 2007). This is especially useful for those new to research as concrete examples of broader issues in research and can also be used to demonstrate the feasibility of combining

quantitative and qualitative methods, without encroaching onto paradigmatic and epistemological conflict (Morgan 2007).

In summary the four concepts demonstrate a range from the specific to the general. They are not opposing beliefs but encased within each other. At the most specific level, paradigms are viewed as examples, or exemplars, of key beliefs that reflect shared beliefs in a community. This directs not only the research question(s) that should be asked, but also the methods used to answer the questions(s). These shared beliefs are founded upon the epistemological stances that reflect a researcher's assumptions about what can be known, and how to attain it. In turn, assumptions arising from the actual nature of knowledge and reality stems from the researcher's worldview itself (Morgan, 2007).

Understanding of these concepts of paradigms influences the selection of research methods. Paradigms also need to be understood in the historical context in which they arose, as a firm grounding is essential to any informative decision, particularly when dealing with views of reality and the nature of knowledge.

Historical debates about the nature of knowledge, meaning, and reality have traditionally loosely fallen into two worldviews, more philosophically and traditionally termed pragmatically as 'positivist' and 'subjectivist', with subsequent evolution into post positivism, interpretivism, and critical theory, and more recently, pragmatism. In order to make an informed decision as to the paradigm of choice for this research, four paradigms will now be considered: Positivism; Interpretivism; Critical Theory; and Pragmatism. They will be explored using the subheadings of: Contributions to Research; Applications to Research; Limitations of use; and Methods employed.

3.4. PARADIGM OF CHOICE

3.4.1. Positivism

Positivism and its ontological and epistemological foundations can be traced to Plato (429 – 347 BC). The path to truth lay in a priori reasoning coupled with deductive logic, so knowledge was obtained through philosophers and other wise men (Johnson & Gray, 2010). The middle ages saw an impetus in the positivist view with the emergence of science, and increased use of experiments. The positivist attitude was further fuelled by the 16th, 17th and 18th Century enlightenment, through scientific revolution, a rational attitude to human improvement, and through the early empiricist

Francis Bacon (1561 – 1626). The 20th Century influence on quantitative research, particularly in the natural sciences arose with Albert Einstein's (1879-1955) theory of relativity and quantum mechanics, and so logical positivism was founded. It claimed that the only true knowledge was that found in science, relying on verification of a universal proposition through empirical research (Johnson & Gray, 2010). It was based on rigid rules of logic and measurement, truth, absolute principles and prediction (Weaver & Olsen, 2006).

Contributions

Positivists believe in a singular reality, that the one and only truth is in the real world 'out there', a world of evidence that can be discovered by objective and value free inquiry, and context free generalisations are possible (Dyson & Brown, 2006). The aim of positivist research is to gain knowledge of this objective, quantifiable, and universal reality, through the acquisition of facts obtained through controlled, replicable and objective observation or experiment (Dyson & Brown, 2006). It seeks to produce theories of empirical connections or investigate patterns between indicators of a social phenomenon. The important feature of the scientific method is that it is *systematic* i.e. rigorous adherence to an agreed set of rules and procedures which allows for evaluation of the research. This minimises possible contamination of results by external factors (Bowling, 2014). Positivism and the scientific method are often aligned with the 'gold standard' of evidence base, and many government agencies and national bodies such as National Institute for Clinical Evidence (NICE) base their guidelines on this view of the world.

Applications

Positivism flourished by the ability of the researcher to be 'value free', (Dyson & Brown, 2006), and thus provided protocols for the way new knowledge could be used for practice, policy, and education. In nursing Florence Nightingale was at the forefront of the movement to use statistics to improve healthcare. Recently, the widespread use of evidence-based guidelines generated from positivist approaches has led to significant improvement in health care outcomes (Playle, 1995). Its main use lies in epidemiology and genetics.

Limitations

The claim for absolute truth is debatable as it assumes a synonymy between the natural and social worlds, and hence both can be studied 'objectively'. It is a world in which causes determine

effects or outcomes, and it is questionable whether this concept can be applied to human behaviour. Applied to nursing research it denies the importance of subjective, social, spiritual, caring, and interpretive aspects of humans. The question of maintaining value free research is questioned due to the inherent fact that observation is based on perception and prior knowledge and experience (Playle, 1995).

Methods

Positivism adopts a clear quantitative approach to investigating phenomena and research methods include: (quasi) experimental designs; true experiments with random assignments; and non-experimental designs such as surveys, and cross sectional and longitudinal studies or questionnaires.

3.4.2. Interpretivism

This world view goes back as far as Protagoras (490-420BC), through to a biblical exegesis, and subsequent critical explanation of text (Johan Dannhauser, 1654, Friedrich Schleiermacher, 1760 - 1884), that later became known as hermeneutics (Vessey, 2009). It arose from phenomenology, the scientific study of the consciousness of individuals (Blaikie, 1993), through the work of Edmund Husserl (1859 - 1938). This was later advanced by Martin Heidegger (1889- 1976), and his in-depth concepts such as *Dasein* (being-in-the-world). Interpretivism is located within a social ontology where reality is socially and experientially constructed and understanding of the human world and experience is obtained through the participant's view. Meaning is unique to the individual and understanding of their interpretations is essential to obtain any theory or patterns of significance (Creswell, 2009).

Contributions

The viewpoint that truth is subjectively perceived yields multiple local and specific realities (Creswell, 2009). In seeking to focus on subjectivity, and elimination of any distance between the subject and the researcher, the researcher immerses in the data to discover meaning and promote understanding (Weaver & Olsen, 2006). This enables interpretations that align with the holistic practice of nursing, but also recognises shared and embedded meanings within and between cultures. Interpretivism can be used to represent and make overt the thoughts, wishes and concerns

of under-represented participants, particularly those hard to reach or the vulnerable (Weaver & Olsen, 2006).

Applications

Interpretivism is increasingly popular in nursing research as it reflects aspects of caring such as: comfort (Morse, 1996); care; and the role of the carer. Within nursing the understanding of meaning is becoming as important as the biological and cultural nature of illness, particularly in life and death issues such as loss and disability. Another example is the use of interpretivism in nurse education addressing the theory -practice gap (Rolfe, 1998). Nursing theory generated from the meaning and reality of practitioner experiences would be more readily applied and adopted than that of a medical and scientific knowledge base. Interpretivism is used to generate practice-based research and not research based practice by many nurse educators and authors (Rolfe, 1998).

Limitations

Loss of objectivity limits its approach to identify and discriminate patterns that are intrinsic to human life and restricts the application of theories to the given context and time within which the research was placed. It therefore may not account for historical, ecological and other intrinsic risk factors (Creswell, 1998). Lack of quantification of data, the generalisability of results, and a lack of reliability and verification is highlighted by those who adhere to a more scientific view of theorising (Creswell, 2009). The importance of being value free comes into question as the researcher needs to be aware of the impact that their own perceptions can have on the research whilst they seek to understand the context within which they are situated (Creswell, 2009). However, interpretive researchers can use the tools of reflexivity to acknowledge value mediation whilst not detracting from the ethos of obtaining understanding and meaning (Houghton et al, 2013).

Methods

Interpretivism adopts a qualitative approach to investigating phenomena such as: ethnography; participant and non-participant observation; field study; phenomenology; narratives, the organisation of information within a story; case studies; open ended question interview techniques; and grounded theory (Flick, 2009).

3.4.3. Critical Theory

Critical Theory originated in the Frankfurt School, and builds on the writings of Karl Marx, Jürgen Habermas, Herbert Marcuse and Paulo Freire (Weaver & Olsen, 2006). Critical theory is focused towards critiquing and changing society through probing; reflective assessment; and revealing assumptions that prevent a true understanding of how the world works. Critical theory propounds that society is built on power relationships and therefore should be analysed critically with the aim of reducing inequalities such as: gender; class; ethnicity; age; culture; and sexual identity (Johnson & Gray, 2010). Horkheimer describes a theory as critical in so far as it aims to:

"...liberate human beings from the circumstances that enslave them" (Horkheimer, 1975, p244).

Contributions

Society within critical theory, is shaped by social; political; culture; gender; and economic factors that over time are perceived and crystallised as 'real', and form truth. Research is located within the totality of society and incorporate all the major sciences such as: geography; economics; sociology; history; anthropology; and psychology. It involves collaborative interaction between the researcher and the researched and is an iterative process of reflection and redefinition of problems (Weaver & Olsen, 2006). The main aim of critical theory is to produce knowledge and insight that challenges institutions, questions dominant regimes of truth, and represents those diverse and underrepresented views that otherwise would not have a voice (Lincoln & Guba, 1985).

Applications

Critical Theory is appealing to researchers aiming to expose inequalities and explore the redistribution of power and resources (MacGuire, 1990), through the ethos of control (Lincoln & Guba, 1985). Its main strength lies in its ability to potentiate action to change inequalities by the co-formulation with the researched of an action agenda. This not only ensures that marginalised groups or individuals have a tool for representation, but also a strategy that empowers them to transcend race, class, and gender constraints (Creswell, 2009).

Limitations

The main criticism of critical theory has been the focus on communities and groups to the detriment of individuals (Campbell & Bunting, 1991). Involvement with participants located in a society within which they had no control over creating, can be an ethical issue in demeaning individual meanings (Campbell & Bunting, 1991). Researchers have been criticised for their complicity in belonging to the culture they critique, and for suppressing findings not aligned with their beliefs (Weaver & Olsen, 2006).

Methods

Critical social theory adopts the qualitative methods of: participant and nonparticipant observation, It can also use: action research, that aims to transform inquiry into action through co-participation; and focus groups, where groups are involved to discuss the issues under study (Flick, 2009).

3.4.4. Pragmatism

Pragmatism arose from a set of overlapping ideas attributed to three main American philosophers in the 18th Century: Charles Sanders Peirce (1839 1914); William James (1842 - 1910); and John Dewey (1859 - 1952) (Johnson & Onwuegbuzie, 2004). Pragmatism adopts a practical philosophical view, that there are multiple realities that can be inquired through empirical means, the emphasis being on solving practical issues or problems in the 'real world' (Dewey, 1925). Pragmatists are empirical by nature, and view knowledge as the relationships between action and consequences, and objects of knowledge as resulting constructions formed out of interactions between humans and their environment (Biesta & Burbules, 2003). Truth is always situated within the social and natural environment.

Contributions

Pragmatism does not focus on the process of the research but rather the outcome and its consequences (Johnson & Onwuegbuzie, 2004), through an 'action focused, action-knowledge' framework which directs the research. The researcher utilises a variety of research tools and modes of engagement with participants that address the research question, and therefore a pluralism of processes of induction, deduction and/or abduction is adopted to meet the research needs (Morgan,

2007). This openness to employ appropriate tools for the research, coined 'everyday pragmatism' (Biesta, 2010), entails employing a mixture of research methods engage and optimally inform the research (Greene & Hall, 2010). The use of multiple sources of evidence allows an informed approach to problem solving, to consider all actions and consequences of possible solutions (Greene & Hall, 2010), and their impact and value in a specific situation.

Applications

Mixing methods helps researchers to obtain valued outcomes i.e. understanding, description, explanation, prediction, improved practices, improved lives, reductions in inequality, and social justice. The aim is to obtain useful answers to the research question that are situational, and contextual practice-based solutions (Weaver & Olsen, 2006). It offers theory construction tailor made to nursing situations and contexts, practice based, which can promote nursing beyond the boundaries of a singular style paradigm, and the wellbeing of all those involved in nursing (Weaver & Olsen, 2006).

Limitations

Plurality may not be the most appropriate approach to answering the research question, and a single paradigm may be more efficient, even with its inherent weaknesses (Dixon-Woods et al, 2005). It is important to establish a purpose for mixing of methods, which relates back to the research question and the chosen paradigm. In pragmatism the research question(s) determines a plurality of approaches, not vice versa. There is the possibility of favouring one method over another due to researcher familiarity with either one, the timing and importance of each method being used, and equity in publication (Dixon-Woods et al, 2005). The overall view to diminish these limitations is only using mixed methods when it is the most appropriate strategy to do so.

Methods

Pragmatism encompasses all the methods from positivist, interpretivist, and critical theory paradigms, but then uses triangulation to provide the best evidence available to answer the research question, It encompasses: experimental designs; non experimental designs; narratives; phenomenology; ethnography; grounded theory; case studies; focus groups; action research; and participant and non-participant observation (Creswell, 2009).

Positivism, Interpretivism, Critical Theory and Pragmatism present four potential paradigms for this study. Each have strengths, weaknesses, applications and methods. These are summarised and presented side by side in Table 3.1.

Table 3.1: Summary of Paradigms			
Item	Positivism	Interpretivism	Critical Theory
Ontology	<p>Singular reality “out there” which is objective and quantifiable.</p> <p>Hidden rules govern teaching and learning process</p>	<p>Relativist – multiple contextual and situational constructed realities</p>	<p>Historical realism, shaped by social, political, ethnic, gender and economic factors that become definitive over time.</p>
Epistemology	<p>Theory established deductively through the scientific method.</p> <p>Focus on reliable and valid tools to uncover rules</p>	<p>Being-in-the-world intersubjectivity</p> <p>Inductive theory generation and understanding</p>	<p>Subjectivist, transactional, collaborative</p> <p>Inductive action theory</p>
Question	What works?	Why do you act this way?	How can I change this situation?
Methodology	<ul style="list-style-type: none"> • Experimental design • Quasi experimental • Non-experimental survey • Structured interviews with the aim of generalisation 	<ul style="list-style-type: none"> • Ethnography • Phenomenology • Grounded Theory • Case Study • Narratives 	<ul style="list-style-type: none"> • Participant observation • Non-participant observation • Action Research • Focus groups

3.5. Rationale for the research design

The decision to be made amongst these approaches remains entirely within the focus of the research question:

In order to optimise critically ill adults for transfer to regional ECMO centres, what can be learnt from transport nurses in maintaining patient stability following referral?

To answer the question fully a two-pronged approach was required. To appreciate the transport nurses action directed toward the patient necessitates a clear picture of the patient(s) profile with regard to age, weight, stage of critical illness, and the physiological condition of the patient. This is the reality that the transport nurse is faced with. The information obtained would then place in context the rationale for the transport nurses acting in certain ways to enhance patient stability. Reflection on these reactions to the patient profile would then enlighten the answer to the lessons that could be learnt from transport nurses in order to both optimise and maintain patient stability following referral. In order to clarify the patient profile and comprehend transport nurses' reactions both quantitative and qualitative approaches were required. The paradigms reviewed were then considered regarding the research question.

Positivism would provide data rich in facts, meets the criteria for credibility, possesses the ability to acquire data through controlled, replicable and objective measures, and can be analysed statistically. It is the preferred method for agencies and National Bodies and is used in producing evidence-based guidelines. It is best suited to answer questions such as 'what works?'. The literature review demonstrated that quantitative data yielded information such as: deterioration in patients' physiological parameters (Forrest et al, 2011); the number and type of critical transport incidents (Flabouris et al, 2006); and identified the risks of transport. As such the paradigm could be used in the context of the research question to employ methods such as surveys, questionnaires, or Medical Records Review (MRR), to abstract the physiological variables of the critically ill adults during the different stages of the transport process (Wiegersma et al, 2011). It could also be used to highlight the risks of critical illness and transport (Roch et al, 2014), and utilisation of mobile ECMO akin to Forrest et al, 2011. The transport logs will also clarify the number and type of transport incidents should they arise as utilised by Flabouris et al, 2006. The literature review however also highlighted the lack of explanation or understanding of events that occurred within transport, and the paucity of

qualitative research. Positivism is limited in its view of a singular objective reality, and does not take into account subjectivity, or situation and context, ignoring proactive and reactive actions arising from human thoughts, feelings, and behaviour. This inability to abstract the contextual and situational aspect of the transport nurse, their cognition and reflection of their behaviour, their concerns and fears for patient safety, would therefore not answer the research question in its entirety.

Interpretivism would provide a good platform for the research question in that reality is socially and experientially constructed, recognises the participants' own view of the phenomena, acknowledges that there are multiple views, and answers the question of 'why did you act in this way?' The critical incident study by Gustaffson et al (2010), demonstrated the depth of information that can be obtained using interviews and the rich description of real-life worries and concerns of transport nurses being used to impact on nursing education and practice. To obtain information regarding the transport nurse it is essential for the researcher to get close to the subject of study to achieve an understanding of behaviour, whilst acknowledging that small scale research can present difficulties in generalisability and replicability (Lincoln & Guba, 1985). However, the primacy of its subjectivity restricts application of indicative theories to time and place, whilst not acknowledging internal and external risk factors. This decreases its generalisability to specific contexts of time and place. Transport nursing takes place all over the world in different time, places, and resources, and with varying degrees of risk factors. A study involving transport and transport nurses needs to not only acknowledge these risk factors but also to apply what can be learnt to other substantive areas. Interpretivism is not a suitable paradigm to wholly explain, understand, and apply any findings to future transport processes regardless of context.

Critical Social Theory, being an action –focused paradigm with the focus on producing a strategy for change, is appealing to any researcher in an arena where inequalities are deemed to necessitate such a strategy. It provides an in-depth view of the phenomena, and engagement with the participants promotes knowledge and insight. It is useful in answering action-based questions such as 'how can I change this?', with a focus on critiquing and changing society, and more suited to political and contentious issues. The focus on this study however concerns itself not on the distribution of power and control, but more locally on promoting stability, safety and optimisation of critically ill adults, and more specifically the part transport nurses act in this process. Critical theory is therefore not considered as a paradigm in this study.

To answer the research question fully, the use of quantitative data would elicit a breadth of information regarding the patient profile, and changes in physiological parameters, whilst qualitative data would yield the depth regarding the activities, perceptions, and feelings of the transport nurses' during the patient's journey. The best way to obtain both views was to consider a paradigm that allowed both types of data i.e. pragmatism.

3.5.1. Pragmatism

As an experienced clinical nurse, I have always considered myself to be 'pragmatic', equating the term as an adjective denoting the practical side of nursing. This initial lean towards pragmatism encouraged a deeper understanding of the paradigm, and with it a justification of its utilisation within this study. The Oxford English Dictionary (2016) defines pragmatism as a philosophy that evaluates assertions based solely by their practical consequences and bearings on human interests. Arising during the eighteenth-century Peirce (1903), created the term pragmatism symbolizing a philosophy that has a distinct approach to truth, method, and meaning (Frankel Pratt, 2016).

Bacon (2012), notes that according to James (1978), truth is challenged through tracing the practical consequences of different ideas, and theories arise when historical or fixed explanations are challenged by new experiences or ideas, and theories become the tools to reconstruct reality. Assimilation of new and old ideas, rather than replacement, ensures theory development is evolutionary rather than revolutionary (James, 1978). This approach ensures answers to the questions inherent in this paradigm such as 'will this intervention improve learning?', thereby encompassing the central tenet of the research question in this study. Dewey similarly strove to promote pragmatism through an emphasis on human experience rather than focusing upon abstract concerns (Dewey, 1902, 1922, 1925). Experience, he proposed, was built around two inseparable questions: What are the sources of our beliefs; and what are the meanings of our actions? (Morgan, 2007). The answers to these questions lie within a cycle in that, the origins of our beliefs arise from prior actions, and the outcomes of our actions are found in our beliefs. For Dewey (1902, 1922, 1925), meanings are created by experiences within which beliefs and actions are in contact with each other. Applied to this study then, a belief in the efficacy of ECMO translates to being involved in the retrieval of patients for ECMO, a belief that is reinforced by prior ECMO and transport experience, and a successful outcome of transport and the patient on ECMO promotes further action, and reinforces belief in ECMO.

Experience then involves a process of interpretation. Actions must be interpreted to generate beliefs, and beliefs must be interpreted to generate action (Morgan, 2007), with the result that actions as outcomes of inquiry then serve as the basis for beliefs. This model is represented in the following Figure 3.1.

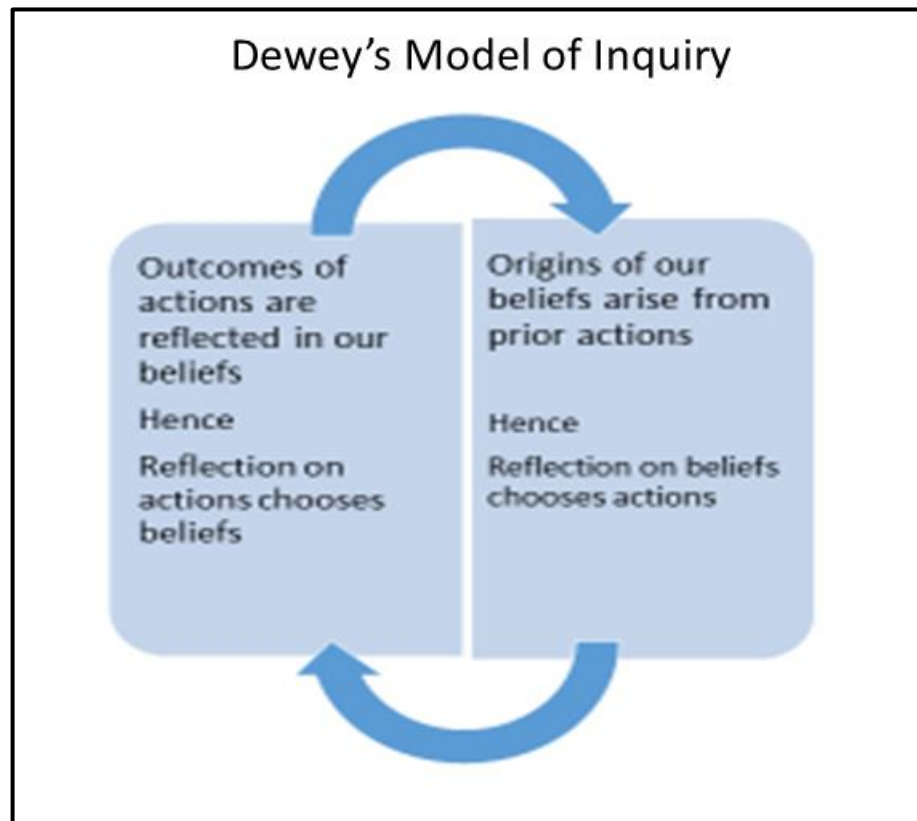


Figure 3.1. Dewey's Model of Inquiry

Not all experiences require careful decision making and occur in a semi-automatic accepted manner which Dewey termed *habit* (Dewey, 1922, 1925). In these instances, beliefs acquired from previous experiences are adequate to cope with the demands for action (Morgan, 2007).

In contrast, experiences that require thoughtful reflection, cognition, and conscious decision making, then what occurs according to Dewey, is *inquiry* (Dewey, 1922, 1925). It is to be observed that for Dewey inquiry and research are treated as synonyms, which serves to highlight the

importance in the research process of careful and reflective decision making (Morgan, 2007). All experiences though, whether habit or active inquiry take place in specific contexts (Morgan, 2007). These contexts occur, according to Dewey (Bacon, 2012) through the pragmatic perspective of *intersubjectivity*, where humans live and act together, and possess a shared responsibility such as : thinking; co-operating; and communicating (Rorty, 1999, Biesta & Burbules, 2003, Johnson & Onwuegbuzie, 2004). These interactions , or *transactions*, occur as an individual adapts to the environment through a change process, informed by prior experiences through which their world is created (Biesta & Burbules, 2003). Previous and current experiences represent not only knowledge acquisition but also refinement, when reflection and action are combined (Biesta, 2010). All human knowledge is therefore empirical, and truth arising from knowledge is always situated, not only historically and culturally, but also within the social and natural environment. This concept aligns itself with Kuhn's paradigm version of a paradigm representing shared beliefs amongst members of the same community (Morgan, 2007).

This actionable knowledge becomes an active process of establishing assertions, becoming *warranted* assertions that are the outcomes of using beliefs in practice where knowledge cannot be separated from doing. These warrants are applied to a specific context but could be actionable in other contexts and new experiences (Johnson & Onwuegbuzie, 2004, Greene & Hall, 2010). This process of actionable knowledge, through reflection and reasoning, can appear as if the connections between actions and beliefs are based on cold rationality. Dewey however, argued that there is always an emotional embodied element to experiences, and the link between actions and beliefs are maintained and strengthened by feelings.

Scott & Briggs (2009), argue that as all human knowledge is empirical, which cannot be framed without actually learning what works in practice, then research within clinical practice, which is pragmatic, empirical, and situated, should be conducted within the pragmatic paradigm.

Situated inquiry within the clinical environment begins with uncertainty with the aim of establishing warranted assertions, involving clinical expertise from clinical knowledge, experience, skill and opinion, using a multitude of data and interpretation to form evidence based, patient focused care.

Healthcare involves situated inquiry, starting with uncertainty and moving towards warranted assertions, and a plan that works for the patient and the clinician. This is derived from the human expertise of the clinician in whatever specialty bringing to bear knowledge, experience, skill, and opinion to provide patient based care on a plurality of data and interpretation (Scott & Briggs, 2009).

Clinical judgement is at the heart of medical practice, a view shared by Benner and colleagues in their research on critical care nursing, involving intuition, experiential learning, clinical reasoning, thinking-in-action, reasoning-in-transition, skilled know how and perceptual acuity (Benner, Hooper Kyriakidis, & Stannard, 1999).

Pragmatism offers an approach to nursing research which considers focus and situation and tries to understand practical wisdom. Montgomery characterized clinical judgement using a term from Aristotle, that of *phronesis*, practical wisdom and reasoning behind clinical judgement and action (Montgomery, 2006). Intensive care nursing is situated and contingent and requires a paradigm that recognises links between beliefs and actions, and acknowledges clinical expertise acquired from a variety of sources.

Nurses are practitioners and pragmatic by nature. My initial leaning towards pragmatism was around the idea of a 'practical' paradigm for practice-based nursing. Further exploration of the paradigm shows that idea of practice is interlinked with beliefs and action. In fact, the term pragmatism derives from the Greek πράγμα, meaning action, the origin of the words practice and practical (Thayer & Rosenthal, 2017). Dewey's model of inquiry also acknowledges the importance of cognition and emotion. James (1978), too considered the strong feeling was the motive for action, both external (movement), and internal (reasoning).

Pragmatism also allows the research question to drive the methods used to explore the situated inquiry or phenomenon. Peirce (1903), argues for a pluralist approach to research methods and was opposed to the use of a singular approach of inference, which Creswell later in 2009, agrees, and states that pragmatism gives researchers the methodological freedom choice.

In summary pragmatism as a philosophy for this research, offered me as a novice researcher a practical, practice based starting point. It allows the research to be situated and contextual, with the freedom to obtain data that was pertinent and applicable to the research question and not limited to a single method. Its main tenet of the cycle of inquiry through beliefs and actions leads to warrants that are situationally and socially constructed. Therefore, what can be learnt from the transport nurses arises from research in the situation but also considers their actions stemming from cognitive beliefs, which affirm and account for further actions. In this way, pragmatism also looks to the future as an evolvement of future practice, an iterative rather than static process. Having decided on the paradigm the next step was to consider the tools to obtain the data.

Mixed methods research was considered, as it offers a plurality of methods and therefore achieving a two-pronged approach to fully answer the research question. Mixed methods have existed since the early 20th Century, with much social scientific work using multiple of mixed methods, although the practice remained largely invisible, or not acknowledged (Hesse-Biber, 2010). Research that utilised and integrated positivism and subjectivism, marked a new era in conceptual thought in the social, behavioural, and human sciences (Johnson, Onwuegbuzie, & Turner, 2007). It was hailed as a response to the non-productive debates over the paradigm 'wars' of qualitative and quantitative research (Creswell & Plano Clark, 2007). The use of mixed methods to not only attain but modify knowledge allows an informed approach to problem solving with an iterative process of reflection. This allows consideration of actions and consequences of the proposed or possible solutions, and their impact and value in a specific situation (Greene & Hall, 2010).

Mixed methods give different perspectives from the data and can be a powerfully exploratory and explanatory tool to gain understanding and a more comprehensive picture. The key to achieve this lies in the integration of the methods termed *triangulation*. Originally a tool for validation it aids convergence in findings, ensuring variance in findings are not an intrinsic property of the methods used, but related to the phenomenon under investigation (Campbell & Fiske, 1959). The core of *mixing* in mixed methods refers to the 'strands' or components of the basic processes involved in conducting the study from initiation to interpretation (Teddle & Tashakkori, 2009). The design refers to the decisions made regarding: the level of interaction between the strands; the relative priority of the strands and the procedures for mixing the strands. There are many combinations of designs proposed by different mixed methods researchers such as Morse (1991), Greene (2007), Nastasi, Hitchcock & Brown (2010), and Teddlie and Yu (2007), which increase in complexity as the utilisation of mixed methods evolves.

My initial idea was to use mixed methods under the pragmatic paradigm. The results from the quantitative data not only led to a rethink of the research question but also the use of mixed methods and in particular triangulation. Methodological triangulation, the use of multiple methods to clarify and understand research (Denzin, 1978), and *between methods* triangulation, which uses both quantitative and qualitative approaches in the same study (Denzin, 1978). Integration of quantitative and qualitative data proved difficult from the start. Triangulation with the collection of both approaches did not as planned occur simultaneously, the qualitative data using grounded theory took considerable time, whilst medical records data collection was quicker. Analysing both types of data was also not in time synchrony. On analysis, time was spent on integrating the findings of the

quantitative data showing little deterioration in the patient physiological profile and the actions of the transport nurse in preventing deterioration and optimising stability. On reflection of these attempts I was frustrated with trying to adhere to the tenets of triangulation throughout all the research process, only partly achieving this in the results section. Advice from an expert in grounded theory, revealed that this method of inductively generating theory need not, as I naively assumed, be limited to qualitative data, but as a methodology incorporates all types of data. The focus then shifted onto further consideration of grounded theory, under pragmatism, as the overarching methodological strategy for the research. This is shown in Table 3.2.

Table 3.2: Grounded Theory approach chosen for this study					
Research Question	Paradigm	Strategy	Sampling	Data Collection Methods through the patient journey	Type of results
In order to optimise critically ill adults for transfer to regional ECMO centres, what can be learnt from transport nurses in maintaining patient stability following referral?	Pragmatism	Grounded Theory	Random Sampling	Medical Records Review: Referral Pro formae Transport Logs ELSO Data Medical Notes	Holistic description of the practical real work experiences through the patient journey, to aid understanding and explanation in optimisation and stability of critically ill adults transfer to regional ECMO centres.
			Unstructured Interviews	Concurrent systematic collection and analysis of data from interviews with transport nurses	

3.5.2. Grounded Theory Methodology

Grounded theory is inductive research that produces substantive or formal theory, through the generation of emergent conceptualisations into cohesive patterns, comprising of categories and their properties (Glaser, 2001, Charmaz, 2006). These emergent concepts occur using an iterative constant comparative process intended to generate concepts from all data (Glaser, 2001). This central ethos of the formulation of emergent concepts through grounded theory, allows it to transcend

division between positivism and subjectivism as it uses data across all research methods despite its origin (Glaser, 2001). This focus on conceptual generation can therefore involve tools such as: experimental; survey; medical records; content analysis; and all the qualitative methods available. The substantive or formal theory from conceptualisation, arises through exploring the perceptions and actions of problem solving within a social context (Charmaz, 2006). Transport nursing takes place in a context comprised of different environments and changes in patient acuity, with the central aim being to optimise and maintain patient stability, constrained by time and resources. The situation is compounded by multiple factors: contextual factors; multiple interactions; team working; patient status; policies and procedures; and resources. The emphasis of grounded theory on examining individual awareness, problem solving resolution, and ability to utilise all data within a complex arena, promotes itself as an ideal means to answer the research question.

Grounded theory has emerged and evolved over time into different schools of thought. It is important therefore to understand its history and demonstrate its evolution in order to appreciate the rationale for the particular grounded theory school chosen for this research.

Grounded theory arose with '*The Discovery of Grounded Theory*' (Glaser & Strauss, 1967), in an era of disenchantment of the mechanistic mode, the logico-deductive theory and obtaining verification through precise quantification to gain 'truth' (Charmaz, 2006). This primacy of verification was challenged by Glaser and Strauss (1967), with the argument that grounded theory was methodical, had guidelines and procedures for data collection and analysis, and formed theoretical frameworks that gave an explanation of the resultant data and thus gained 'legitimacy' (Charmaz, 2006). This gave qualitative research a transparency, a visibility, which was not only comprehensible, but also replicable (Charmaz, 2006). To generate theory the researcher immerses themselves in the data to generate concepts, using a systematic, inductive, and comparative process. Data is collected through theoretical sampling, coded, and categorised using analytical codes derived from the data, using a constant comparative method. The use of memos during this process enables elaboration, definition and specification of these categories. The iterative process of moving between empirical data and emerging analysis enables shaping and refining to the construction of the emerging theory, and the analysis becoming more 'theoretical' (Bryant & Charmaz, 2007), and less descriptive (Glaser & Strauss, 1967). This notion of 'grounding' the theory, produces an emerging, inductive theory, able to be applied to real life situations, and earned its scientific status through rigorous systemisation, with the aim as Burawoy states to:

'turn our data into the very best scientific theory' (Burawoy, 1998, p275)

It also allows research to be conducted in areas previously not investigated, or to plug the gap in existing research (Schreiber & Stern 2001b). The initial phase arose from a collaboration between Glaser (1930- present) and Strauss (1916 - 1996), and was a product of two different methodological points of view. Glaser possessed inherent positivistic and objectivist leanings, erring towards logic, systemisation and emergent discoveries. Strauss had inherent qualitative, social interactionism, and pragmatic leanings, erring towards human agency, social and subjective meanings, open ended study, and emergent processes (Charmaz, 2006). In undertaking research into dying patients, families and hospital staff, Glaser and Strauss developed the grounded theory method. They launched their method in their seminal work, *The Discovery of Grounded Theory: Strategies for Qualitative Research* (Glaser & Strauss, 1967). Criticism arose regarding the lack of sufficient guidance in conducting the research (Bryant & Charmaz, 2007). In response, Glaser published, *Theoretical Sensitivity* (1978), providing further clarity to the process. The publication of *Basics of Qualitative Research: Grounded Theory Procedures and Techniques* (1990), a collaboration with Strauss and Corbin, revealed a detailed and stepwise approach to structure the data, and to clarify the relationships between categories (Strauss & Corbin, 1990). Following this, Glaser continued to publish his own conceptualization of grounded theory (Charmaz, 2006). Strauss and Corbin introduced a systematic and sequential way to process and relate the different categories arising from the data, termed conceptual matrix, claiming that the model enriched the analysis of data (Strauss & Corbin, 1990). Glaser's critique of this model was that forcing preconceived ideas on the data ignored the concept of theoretical coding, and was too formulaic (Glaser, 1992). A constructivist perspective on grounded theory arose through the work of Charmaz (Charmaz, 2006, Bryant & Charmaz, 2007). The constructivist viewpoint situates the researcher in partnership with participants about the phenomenon under scrutiny, interpreting constructed meanings between the researcher and the researched, and co constructing theory (Charmaz, 2006), as opposed to the discovery of a grounded theory (Glaser, 1978, 1998, Glaser & Strauss, 1967). This focus on interactions distorts grounded theory rather than achieving the level of abstraction required to produce a conceptual theory.

Outlining the development of grounded theory has identified three main strands reflecting the ontological and epistemological positions of each: the Glaserian, or classic perspective: the Straussian perspective; and the constructivist perspective.

Classical grounded theory has adhered to the original premise of generating theory, and exploring problems perceived to be important for those involved (Glaser, 1978). It seeks to produce a situational, and contextual theory, through the process of constant comparison between categories emerging from the data, rather than trying to force data into pre-conceived categories (Glaser & Strauss, 1967). Through a process of theorizing and abstracting, the data is transformed to attain a conceptual level. Theory generation in classical grounded theory is underpinned by comparison; emergence; and conceptualisation. The researcher possesses few preconceived ideas to minimise bias, force the data, or to detract from what the participants perceive to be the problem (Glaser, 1992). Initially this also applied to the ethos of not reviewing literature until the core category was emerging (Glaser & Strauss, 1967, Glaser, 1978). This can prove impractical when subject to institutional policies and procedures inherent in any research study. Recently Glaser (1998, 2004), permitted the use of relevant literature with the saying that 'all is data', and positioning the researcher as possessing some knowledge to orientate and direct, but having an open and objective mind when generating the theory process (Walls et al, 2010). The researcher should be aware of the influence their knowledge and clinical experience may have on their research. Classical grounded theory has been criticised for its apparent positivistic ontology, an objective reality, with external data, that does not account for the context in which it is situated (Annels, 1996, Bryant & Charmaz, 2007). Glaser never discussed ontological or epistemological foundations in his writing (Nathaniel, 2011), and as Wuest (2012), states, emphasis should lie on the fact that classical grounded theory can traverse paradigms with its multiple viewpoints, so philosophical discussion is entirely rhetoric. Overall, those who adopt the classic grounded theory perspective find the more open approach to data analysis more liberating (Melia, 1996, McCallin, 2003, Heath & Cowley, 2004).

Strauss and Corbin deviated from classic inductive grounded theory with an emphasis on demystifying the original coding, by the utilisation of a conditional matrix. Using a combined inductive/deductive approach, a conceptual framework enabled theory to be checked against the data, guide analysis and ensure rigour. It can be argued however that use of a conditional matrix (Charmaz, 2006), whilst offering a systemic stepwise process, and attractive to the novice researcher, lacked the imagination and flair that was an important element in classic grounded theory (Bryant & Charmaz, 2007). Glaser (1992) comments that the central ethos has moved from theory generation to verification, by its linking of extant theory prior to or during the research. Some see this as a positive element in that the theory directs the focus to answering a particular question rather than producing a specific answer (Dey, 1999). Glaser (1998), counters this claim by suggesting that

relevant questions arising from the data, may be missed by this focus on the theoretical framework. Glaser adds (1992, 1998, 2001, 2004), that Strauss and Corbin's remodelled grounded theory with its unnecessary preconceived elements, can result in concepts being forced into categories.

Those who adopt a Straussian approach favour the clearer guidelines for data analysis, but others (Glaser, 1992, Melia, 1996, McCallin, 2003), argue that their procedures may cloud the analysis and become:

'the technical tail wagging the theoretical dog' (Melia, 1996.p 376)

and researchers may 'look for' the data rather than 'looking at' the data (Robrecht, 1995).

The constructivist school of grounded theory focuses on how the realities within a research process are constructed; the data; the analysis; and the methodological strategies. This includes how the researcher constructs those realities in which they participate: the context; their perspectives; priorities; interactions; and their interpretation of the phenomenon itself. The result is the creation of multiple realities, in line with some philosophical viewpoints. The theories generated in this school are more likely to be 'plausible accounts' (Charmaz, 2006:132), rather than objective knowledge, negating the need for a core category. Glaser has concerns about the multiple realities as applied to this concept, as it can lead to multiple forcing of the data (2001, 2004), and questions Charmaz's claim that constructivist grounded theory uses flexible heuristic strategies as opposed to formulaic procedures, which was the original premise of classical grounded theory.

The decision of which of the three schools of grounded theory was made only the basis of being the most pertinent to the research, but also with regard to ease of application and process as applied to myself as a novice grounded theory methodologist.

Strauss and Corbin were rejected as far from demystifying the coding process, it appeared to be too complicated with the use of the conditional matrix. Its prescriptiveness seemed to limit creativity within the researcher, a restriction I felt would lead to a tendency to 'locate' the data rather than allowing it to emerge. As this research on transport nurses was, judging by the literature review, relatively new, I wanted to be open to the emergence of any concepts, consider them equally, and allow constant comparison to give them their appropriate credence. The conditional matrix may not result in locating emerging important concepts, through lack of reflection and abstraction.

The Constructivist grounded theory although descriptive in its explanation of the generation of theory (Charmaz, 2006), was rejected on the pragmatic reasoning that co construction and equal participation in the research process present difficulties when applied to actual research practice (Hunter et al, 2011). This is especially difficult for the novice researcher. It is also criticised for relying on description rather than elevating abstracts concepts to theory (Glaser, 2001). Constructivist grounded theory has the potential to reveal hidden hierarchical power structures (Charmaz, 2006). Power imbalances are not the focus in this research so for all these reasons, constructivist grounded theory is rejected.

The classic grounded theory was not a perfect methodology to understand and use, but has come of age with ideas such as; 'theoretical sensitivity', and is an approach that appears to offer a more simplistic, purer way of generating inductive grounded theory, untainted by too many external influences such as politics, and multiple perspectives. It is focused and applied to the problem at hand, whilst offering practical application of its findings. Glaser's (2001) central tenet of generating conceptualisations, using all data, whether quantitative or qualitative, was also key in the decision to use classic grounded theory. It meant the freedom to gain a physiological profile over the patient over the time period of the transport nurses involvement, and a sense of reality of criticality of the patient they were exposed to, whilst obtaining a breadth of their thoughts and actions when dealing with this reality. It offered an opportunity to literally jump in the data, immerse myself in it, see what emerged, and with creativity and imagination, generate concepts into a formal or substantive theory.

As a pragmatic nurse this way of conducting research is appealing, as it is about doing, rather than thinking, as Glaser himself states "*just do the work*" (Glaser 1998, p 27)

Classical grounded theory was therefore used to generate a practical, realistic, and applicable theory to add to the knowledge base surrounding transport nurses.

3.6. Chapter summary

This chapter has outlined the research design, philosophy and its application to research. The philosophy behind any research was considered through clarification of the concept of paradigms. Four paradigms used in nursing research were then outlined. A rationale for the chosen paradigm was given. The methodology utilised in the research was then explored and grounded theory, in particular classical grounded theory identified as the most suitable to answer the research question.

The actual methods of data analysis and collection, using retrospective Medical Records Review and grounded theory analysis of unstructured interviews will be discussed in the next chapter.

4.0. CHAPTER FOUR: STUDY DESIGN APPLIED TO METHODS

4.1. Introduction

This study uses a two phase study design within an overarching pragmatic paradigm, and grounded theory, utilising Medical Records Review (MRR), for the first phase with quantitative data, and grounded theory analysis of unstructured interviews for the second phase. Both phases will be used to inform understanding of how transport nurses optimise and maintain patient stability during transport of critically ill adults to regional ECMO centres. The key to excellence in any research is to specify the research design through which the benchmark criterion of replicability, generalisability, transferability, and transparency can be measured.

The chapter begins by introducing Phase I research methods of MRR, beginning with an overall description, followed by its application to this research. The data collection tool, sampling, rigour, and ethical issues considered in the design of the study are discussed. Phase II, the grounded theory analysis of unstructured interviews is then presented through theoretical sampling, interviewing, outlining the stages of analysis, measures of quality in grounded theory, and ethical approval.

4.2. Phase I: Medical Records Review (MRR)

4.2.1. Introduction to MRR

The Medical Records Review (MRR), sometimes termed as a retrospective records review or a clinical audit, is an essential element in clinical research. It uses both electronic or paper clinical records such as clinical notes, observation charts, outpatient documentation, laboratory reports, diagnostic tests, as a primary source of information to measure variables of interest (McConnell-Henry et al, 2015, Worster & Haines, 2004). MRR can range from a simple audit tool investigating demographic data to multi-faceted tools measuring variables over time, determining relationship between variables, pre and post interventions, identifying certain patient conditions (Rask et al, 2010), and collecting incident and adverse event data (van Melle et al, 2018). In this way, MRR can be used to not only answer clinical research questions but can also measure quality and quality

activity (McConnell-Henry et al, 2015, van Melle et al, 2018), to improve patient care (Buykx et al, 2012). The information is obtained from this pre-recorded, clinically focused, patient data, using pre-determined variables to formulate a data collection tool. The format of these can range from a simple data collection form, comprising of yes/no, and single variables such as age, sex, weight, to more sophisticated methods that can not only note the variables but rank them as well. MRR can, therefore, be used as a stand-alone method, as a primary measure during interventions, or combined with literature searches, questionnaires and interviews to explore factors that may impose on the variables being measured, and as a quality of care evaluation.

Quality of care in an ICU was at the forefront of a study by Eastwood, O'Connell and Considine (2009), employing MMR to obtain a range of data from medical records and nursing charts of 254 patients in the first 24 hours following cardiac surgery, focusing on the use of supplemental oxygen. They obtained a range of physiological data such as oxygen saturation and respiratory rate, combined with oxygen management variables such as mode of oxygen delivery, flow rate, and duration of mechanical ventilation. Their findings showed that suboptimal oxygen delivery was occurring in the ICU environment. Halfon and colleagues, in 2017, used MRR as an indicator of care quality delivered in an acute care hospital in Switzerland. They measured not only the number of adverse incidents in 1,000 patient records, but also scored the incidents as preventable, none or minor impairment, or unpreventable. At the time of the study, the authors cited that that current clinical scrutiny of adverse incidents was inadequate, relying on voluntary reports dependent upon staff inclination and local quality culture, reporting systems that operated at a local level only, and low safety indicators (Halfon et al, 2017). Overall, they felt this gave only a partial picture and not an overall view. They trained seven reviewers and employed a screening tool known to be sensitive to the occurrence of adverse incidents, to examine the clinical records. In a two-step process, any identification of adverse incidents was then further reviewed by a physician to determine possible causes, effects, and the degree of preventability of the incidents. The outcome of the study was an in-depth examination of the two highest categories of adverse incidents and eight clinical practice recommendations.

MRR also has the power to examine variables across time and geography as demonstrated in the study by van Melle et al, in 2018 in the Netherlands. They reviewed information transfer on patients

transitioned between healthcare settings, using the transitional medical records database, following the patients' journey, and the occurrence of inadequate information transfer to identify transitional safety incidents (TSIs). Using combined primary and secondary care records, of 301 patients, they used six trained reviewers to assess these records for evidence of TSIs, using a pilot study to evaluate inter-rater reliability. They identified TSIs in 52 (17.3%). However, inter-rater reliability proved to be variable in the actual research, and therefore low confidence in the reliability of the measurement tool used.

MRR can also be used to measure the impact of interventions. McConnell-Henry et al (2015), used a time series analysis using a clinical simulation environment to observe whether improving knowledge and skills of nurses enhances awareness and observation, and decreases the chances of patient deterioration. The use of a chart audit tool pre- and post-intervention showed significant improvement in clinical care particularly in oxygen therapy and pain scoring, and improved vigilance in the frequency of observations (Buykx et al, 2012).

Rask et al (2010), used MRR as a tool to delineate and identify possible grouping of symptoms in their study of patients with functional somatic symptoms. They underwent a systematic review of medical records using a pre-determined data collection tool and a structured rating form. They discovered that although the tool they designed was useful for identifying diverse types of functional somatic symptoms, the research did not add any new additional information (Rask et al, 2010).

These studies demonstrate that MRR can be used for various types of research within healthcare from single observation, to pre- and post-intervention, and across different settings and geographical areas. The one common element in these clinical enquiries is the prerequisite for designing a data collection tool for extracting the relevant data to assess the nature, incidence, and impact on the patient (Halfon et al, 2017), and address research questions concerning the utilisation, appropriateness and outcome of care (Worster & Haines, 2004). This data collection method allows access to a vast number of records over time, without interrupting clinical practice (Worster & Haines, 2004). The tool itself needs to be efficient in eliciting the required information to address the aims of

the research but also be easy to use both in data collection and data entry (McConnell-Henry et al, 2015).

4.2.2. MRR method applied to this study.

In order for a Medical Records Review to be both efficient and efficacious there needs to be careful planning and preparation regarding the data collection, and preparation of the data collection tool, and data input and analysis (McConnell-Henry et al, 2015).

4.2.3. Data Collection

The literature review of the subject in question is an important step in the process of data collection and designing a data collection tool, once the aims of the MRR have been identified (McConnell-Henry et al, 2015). The aims of using MRR in this research was to investigate the nature and occurrence of physiological changes within the patient over the time frame of the patient journey, in order to explore the wider question of learning from transport nurses in relation to maintaining patient stability. In addition, the use of MRR would also give structure to duration and timings of transfer, and resource management through documenting and adjuncts available to maintain stability of the patient. Thus, the aim of the data collection was to gain an overall picture of patient demographics and quantify physiological variables over time to detect any changes, and occurrences of interventions. The next step was to undertake a literature review of the subject as shown in Chapter 2. The purpose of this was to establish what had already been researched in this field as well as consider the data collection tools used in previous research, the parameters used, sample size, and any limitations encountered. The review showed that a few studies had documented physiological parameters in detail over time, although with different aims from those in this study. There was a mixture of prospective and retrospective studies. Ligtenberg et al (2005), conducted a prospective audit with outlined pre-defined study variables using data sheets and research personnel to assess quality of transport over 14 months. Another prospective audit by Wiegersma et al, (2011), collected patient parameters on 14 variables at various timepoints to ascertain the effects of using a specialist retrieval team. Forrest et al (2011), and Roch et al (2014) used standardised forms to collect patient physiological parameters. The use of retrospective data in the form of transport records was

undertaken by Flabouris et al in 2016 to investigate transport incident Wilcox et al (2017), retrospectively reviewed 239 patient charts and electronic medical records to record on scene times for inter-hospital transport. Retrospective records have also been used to evaluate the use and safety of mobile ECMO through electronic records and databases (Mendes, et al, 2017, Vaja et al, 2015, & Forrest et al, 2011). The latter three all recorded data pertaining to demographics and physiological measures such as cardiovascular and respiratory, ventilation modes, and scores of illness severity such as the SOFA and APACHE scores. Retrospective data was also used by Brewer et al (2009), by reviewing in flight documentation together with qualitative descriptive and phenomenological methods to investigate critical care air transport nurses' deployed experience. The information obtained pertaining to the patient parameters recorded either prospectively or retrospectively was important in highlighting those that may be used in this research. The next stage was to formulate the data collection tool.

4.2.3.1. Data Collection tool

Consultation between the senior medical and nursing ECMO staff, myself and supervisor, led to the formulation of the contents for the data collection tool .Consideration was given to the documentation that was, or could be available, these being the referral pro forma, the transport logs, ECMO documentation, and the patients notes.

Demographics were then considered from those used in previous studies which led to the inclusion of age, weight and ethnicity. According to Chen et al (2011), increasing age is related to a predictive decrease in survival of ECMO. A study by Narotsky et al in 2016, of 131 patients who received VA ECMO showed that those ≥ 65 years had nearly a two-fold higher risk of not surviving to hospital discharge or one year, and this association of age with increased mortality after ECMO has also been found by Guttendorf et al (2014), and Schmidt et al (2014). However, all these studies state that age is not necessarily an independent factor of significance when adjustment for comorbidities has been made. Concerning gender, while some studies have shown that male patients have better outcomes (Hemmila et al, 2004, Combes et al, 2008), others did not find a significant association with sex (Narotsky et al, 2016, Wu et al, 2010, Brogan et al, 2009, Guttendorf et al, 2014). Like age, there could be other confounding factors such as Body Mass Index (BMI), or height (Combes et al, 2008). Ethnicity differences in critical illness can reflect a mix of social, cultural,

environmental, and economic factors in aetiology. Advances in technological testing for genetics influences in ALI showed that it could be more common in people of African descent (Barnes, 2005). One study of black and Asian patients in France did not find an association with race and mortality (Buertheret et al, 2013), as did Wu et al (2010), even though they had a broad representation of patient subgroups. The primary importance of including demographics in research is to address the lament by Narotsky et al, (2016), that generalisability of findings is often limited due to the lack of descriptions of variables such as age, sex, and ethnicity.

The primary diagnosis was collected from the original referral and transport documentation or collected from the patients' notes and could be added retrospectively when confirmed. The number of hours intubated at the time of referral was used to gauge the length of time of the critical illness. Modes of transport, and conventional or mobile ECMO retrieval, were collected as potential factors affecting patient stability. The advice given to the referring hospital on the referral proforma was obtained. Exploration of the transport logs was undertaken to quantify the number and type of interventions, to explore any factors not otherwise captured, and document any recorded incidents. The outcome of the retrieval was also documented.

The physiological variables were the next consideration. The literature review provided examples of variables that had been collected in prior research, which both reflected the severity of illness and could be used at different time points. The eight physiological parameters were agreed with ECMO medical staff and supervision staff at De Montfort University and finalised following the pilot study. The rationale for their choice is also stated in the Table 4.1.

PHYSIOLOGICAL SYSTEM	PHYSIOLOGICAL PARAMETERS	RATIONALE
Respiratory	Haemoglobin	Oxygenation linked to oxygen disassociation curve
	PH	Indication of inadequate tissue perfusion and oxygenation linked to the oxygen disassociation curve
	Partial pressure of Oxygen (PaO ₂)	Function of internal and external respiration
	Partial pressure of Carbon Dioxide (PaCO ₂)	Function of internal and external respiration
	PaO ₂ /FiO ₂ Index	Indication of pulmonary gas exchange and classification of ARDS
Blood	Lactate level	Indication of inadequate tissue perfusion and severity of oxygen depletion
Cardiovascular	Mean Arterial Blood Pressure (MABP)	Indication of critical illness and compromise of cardiovascular system
	Inotropic Support: Adrenaline & Noradrenaline	Level of support required to support myocardial contractility and increase vasodilation in compromised cardiovascular status

Table 4.1. Physiological parameters collected and rationale.

The ratio of the partial pressure of oxygen in arterial blood (PaO₂) to the inspired oxygen fraction (FiO₂) has been used to classify patient's pulmonary gas exchange including the definitions of acute lung injury and of adult respiratory distress syndrome (ARDS). ARDS was defined in 1994 by the American-European Consensus Conference (AECC); and further updated in 2011 due to issues of consensus and reliability. The new definition (the Berlin Definition) was agreed by a panel of European experts and endorsed by the American Thoracic Society and the Society of Critical Care Medicine, after focusing on feasibility, reliability, validity, and objective evaluation of its performance, It defined ARDS as:

- Mild ARDS: ratio is 201 - 300mmHg
 - Moderate ARDS: ratio is 101 - 200 mmHg
 - Severe ARDS: ratio is < 100 mmHg
- (ARDS: The Berlin Definition, 2012).

On assessing all of the documentation the data would be divided into four time points to allow comparisons between patient's physiological parameters to be measured (Figure 4.1):

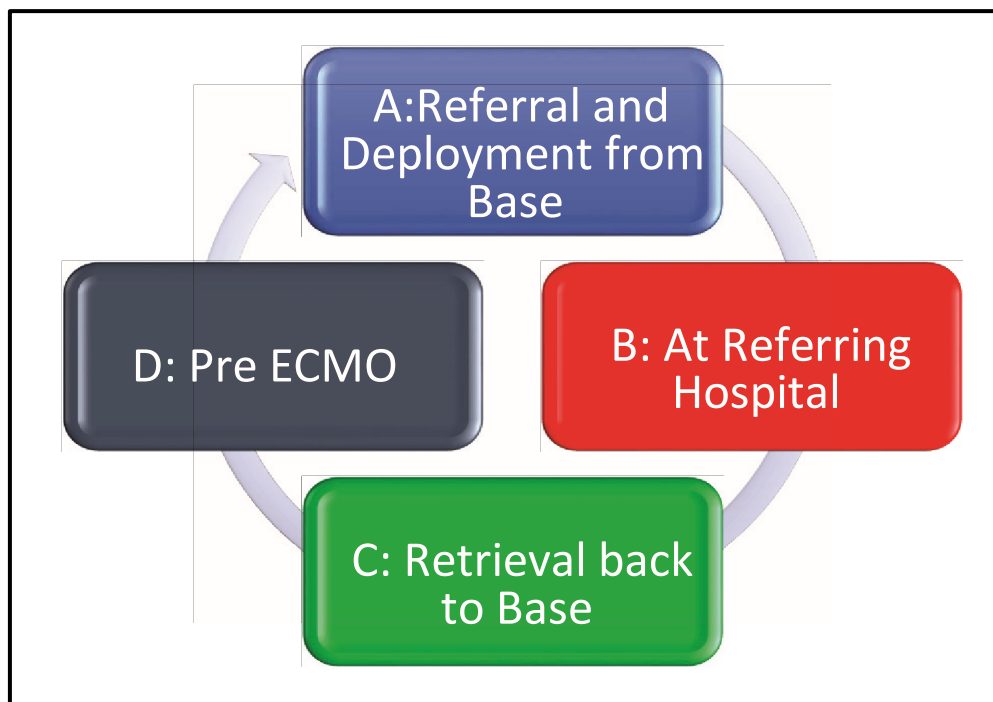


Figure 4.1. Time frames of data collection of physiological variables.

- Point A. Referral and Deployment from Base refers to the data recorded on the referral pro forma (Appendix 7), or transport logs (Appendix 8). Patient's notes were used if data was missing from these forms.
- Point B. At Referring Hospital refers to the data from the transport log at the time of the arrival of the transport team, any immediate interventions that were undertaken in the referring hospital, and whether pre transport advice had been followed.

- Point C. Retrieval back to Base refers to the interventions undertaken by the transport nurse during the journey and the completed transport logistics.
- Point D: Pre ECMO refers to the data collected pertaining to the patient's physiological profile immediately prior to the initiation of ECMO, this may be at the referring hospital or back at base.

The physiological parameters at each of the time Points A, B, and D. This allowed a measure of difference in patient acuity between initial referral; status on arrival of the transport team; and then immediately before ECMO initiation. Point C was not utilised as interventions may vary according to whether conventional or mobile ECMO retrieval.

All the demographic data, variables and time points were then incorporated in the Data Collection tool. A pilot study later refined this, and the final version is shown in Appendix 9.

The advice given to the referring hospital on the referral documentation was obtained. Exploration of the transport logs was undertaken to quantify the number and type of interventions, to explore any other factors not captured, and document any recorded incidents. The research participants were then selected once the data collection tool had been formulated.

4.2.4. Participants

The ECMO co-ordinators at Glenfield receive approximately 200 referrals a year for consideration of ECMO and approximately 45-50 patients a year receive ECMO. The patient details, any advice, and decisions taken during the referral are handwritten on pro forma forms. These are then filed and kept in a locked office.

The data was obtained by simple, random probability sampling of patients referred and admitted for ECMO, between February 2012 to October 2015, throughout England, Scotland and Wales. This ensured that each individual in the accessible population has an equal chance of being selected, to achieve representativeness, and minimising false positives in the statistical relationship amongst

variables (Teddle and Yu, 2007, Denscombe, 2007). Producing a matched sample for patient characteristics (Flick, 2009), was considered, but rejected as the referral is a random event, and not matched for these elements, and thus would not be a true reflection of the population.

The referral files were accessed, and sampling commenced in descending chronological order, omitting patients who did not go on to receive ECMO. The A4 referral files were arranged on a large table and randomly picked. The use of inclusion and exclusion criteria was employed in the sampling.

Inclusion Criteria:

- Adult – 18 years and above
- Meets ECMO admission criteria
- Primary respiratory dysfunction
- VV ECMO
- Retrieved using ECMO transport team
- Conventional Transport
- Mobile ECMO
- Referred from ICUs in England, Wales, Scotland and Northern Ireland

Exclusion Criteria

- Did not receive ECMO due to improvement or deterioration to the point of palliative care
- VA ECMO
- Already on ECMO support
- Co-morbidities
- Transfer between hospitals other than the study site

A retrospective sample of 60 patients was reached, 10 to be used as a pilot study, and 50 for the main research, as it was felt that this represented a years' worth of patients. Once the patients had been identified as meeting the criteria for the research then further information was obtained from

the patients' notes and transport logs, using the data collection tool by myself as a single researcher. If the documentation was incomplete, then the participant was rejected.

4.2.5. Data Analysis

Data was entered into the data editor of the Statistical package for Social Scientists (SPSS) version 20 for Windows. Categorical data for gender, primary diagnosis, mode of retrieval, ethnicity, and outcome was coded, and the codes entered into a codebook (Pallant, 2007). Frequency tables were then applied to this data. The weight, age, length of time intubated at time of referral, and length of time in transport were treated as continuous data and descriptive data obtained showing the range, mean, median, standard deviation as well as the distribution of scores through the skewness and kurtosis values. The data was then checked for errors and cleaned. A pilot study was undertaken to test the quantitative data collection methods once ethical approval was granted. This enabled an assessment between the researcher and the supervising mentor to assess the ease of use, thoroughness, and reliability of the data collection tool, the usefulness of the code book and the statistical tests used.

For the descriptive statistics for the categorical variables of gender, ethnicity, primary diagnosis, mode of retrieval, mode of transport, type of retrieval, and repatriation, frequencies were obtained. For the continuous variables of age, weight, hours intubated at time of referral, descriptives were used to obtain the mean and standard deviation for the data. Within the data collection tool the free text for advice given to the referring hospital, interventions carried out by the transport nurses at the referring hospital, and on the way back, and the number and types of incidents, were counted and grouped into appropriate categories.

The physiological variables over the time frames were entered and tests of normality applied using the Kolmogorov-Smirnov value, which a significant value of $p > .05$ indicates normal distribution of the data. If the data indicated normal distribution then error bars were obtained, and one way repeated measures (ANOVA) as a parametric test, were conducted to compare the scores at 3 time points. Mauchly's test of sphericity were then applied. If the p value was < 0.05 , then degrees of freedom were corrected using Huyn-Feldt estimates of sphericity. For data obtained with violation of normal distribution, box plots were explored and a non parametric Friedman test applied. From this,

if the p value was < 0.05 , then a Wilcoxon pair wise test was conducted to further explore. If the p value was >0.05 then the analysis was complete. This is shown in Figure 4.2

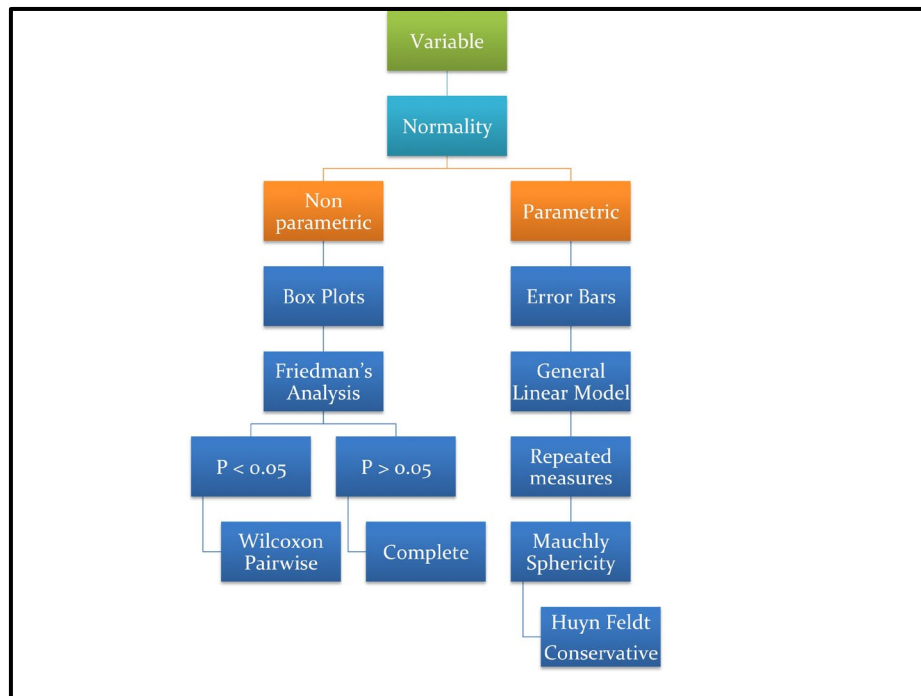


Figure 4.2. Flow chart to show statistical tests employed

4.2.6. Rigour in Phase I: Medical Records Review

Two standards that can be used to evaluate measurements are reliability and validity (Boslaugh & Watters, 2008), and to an extent measurements should have both, but in reality the degree to which an instrument attains these are often specific to the context.

Reliability refers to how consistent or repeatable the measurements used are (Boslaugh & Watters, 2008). It is used in areas such as educational psychology, opinion polling, and behavioural ratings where there is a reliance that the same test used repeatedly will produce similar scores or measures, to ensure that the test, scale, or instrument is reliable. Reliability incorporates three aspects, stability, internal consistency, and equivalence (Polit & Beck, 2014). Stability refers to the degree to which an instrument is susceptible to influences over time such as participant fatigue (Polit & Beck, 2014), and as such is not applicable to MRR. Internal consistency measures how much the

items on a test are measuring the same thing or concept, such as empathy (Polit & Beck, 2014), and is dependent on the correlation of each item on the scale with each other item. As a MRR is an audit as opposed to a measurement scale the internal consistency is not a consideration when referring to a MRR. What is important is the concept of equivalence, the degree to which two or more independent coders agree about the scoring on an instrument (Boslaugh & Waters, 2008, Polit & Beck, 2014), the inter rater reliability. This aspect is considered in MRR studies where more than one researcher or auditor is employed in data collection. The study by van Melle et al, (2018), within which six reviewers assessed primary and secondary records to document evidence of transitional safety incidents (TSIs). The study showed that inter-rater reliability was low, despite a pilot study, with reviewers differing significantly in identifying what constituted TSI's, acknowledging that a lack of shared definitions of a TSI, and a debatable quality in some of the documentation contributed to this result. Attention to inter-rater reliability then is required if one or more than one data collection reviewer is employed, together with preparation through training of auditors and pilot testing (McConnell-Henry et al, 2015). Inter-rater reliability would have been utilised in this study if more than one auditor were used. This would have given valuable insight into the ease of use, and highlighted areas of concern or controversy in the data collection tool. Unfortunately, resources were not available to facilitate this aspect of reliability.

Validity concerns itself with how well a test or rating scale measures what it is supposed to measure, or the acquisition of evidence to aid the types of inferences intended to be derived from the measurements in question (Boslaugh & Watters, 2008). There are several debates about the categories of validity the most common being content validity, criterion-related validity, and construct validity (Polit & Beck, 2014). Content validity is an important consideration in MRR as the data collection tool should be designed so that it has the appropriate sample of items for the construct being measured, and aim to exclude extraneous items (Polit & Beck, 2014, McConnell-Henry et al, 2015). Content validity in MRR is often obtained through the review of the data collection tool by external experts. There are no totally objective ways to measure this criterion instead researchers can calculate a content validity index, as used by McConnell-Henry et al, in their 2015 study. The index was not used in this study, instead attention was paid to careful drafting of the data collection tool using previous studies and expert consensus. Drafting of the MRR tool entailed considering the items and physiological parameters to be used. Following the literature and noting the parameters used by Forrest et al (2011), Wiegersma et al (2011), and Roch et al (2014), a draft data collection

tool was formulated. The items on the tool were then considered by my academic supervisor and ECMO team at the base hospital. They familiarised themselves with the study aims to ensure that it would capture the relevant information required for the study, thus striving to attain a degree of content validity. The pilot study was carried out on 10 patients. Each item on the data collection tool was included following the literature review, peer review, and then rationalised as outlined in section 4.1.2.2. This was reviewed after the pilot study and extraneous items such as base excess, and bicarbonate were excluded as they not deemed to be of benefit to the aims of the data collection. More space was allocated on the data collection tool for recording of transport incidents and other comments. Also, further markers were utilised to indicate where the data could be found (referral pro forma, transport logs, medical records, ECMO documentation), which made subsequent data collection more prescriptive. Refining of the data collection tool, and the statistical code book were a useful exercise. The Berlin definition of ARDS was found to be a good indicator of critical illness, and the statistical tests both descriptive and inferential were chosen. In addition the physiological measures themselves were relatively accurate and precise as they were documented from biophysiologic instrumentation, more objective, and less prone to distortion (Polit & Beck, 2014). Content validity was important in ensuring that the data collection tool had the correct sample of items to measure the construct of critical illness (Polit & Beck, 2014).

Criterion related validity relates to the degree to which scores on a measure or instrument relate to an external criterion, was not applicable as the MRR is an audit tool and not measuring an overall score of critical illness in relation to an external agreed criteria of illness (Polit & Beck, 2014). Similarly, criterion validity relates more to hypotheses testing, and the degree to which an instrument measures the construct under investigation, again not applicable in MRR.

Although the latter were not applicable in this study there were other ways to increase the degree of validity. The number of participants is a major consideration in quantitative research with relation to validity (Polit & Beck, 2014). The larger the sample, the less chance of sampling errors and maximizing the representation of the population as a whole (Polit & Beck, 2014). The data was collected from a total of 66 patients, 10 for the initial pilot study, a further 50 for the main study, and six were rejected due to incomplete documentation. In the NHS England (2016) paper on 'NHS Providers of highly specialised services and the UK wide community commissioning arrangement',

the authors projected that between 200 – 300 adults would be requiring respiratory ECMO annually. Thus, a sample of 50 patients would represent between 16.6% – 25% of the annual adult ECMO population and 100% of the adult population annually at the base hospital. The inclusion and exclusion criteria were then applied.

Random sampling of patients was chosen to minimise confounding variables such as patient characteristics of weight, gender, ethnicity, and age, which could influence the research outcome (Polit & Beck, 2014), whilst also increasing its generalisability. A MRR should then be able to show a comprehensive picture, identifying correlations, from which assumptions or inferences can be made to inform clinical practice and care quality (McConnell-Henry, 2015, Worster & Haines, 2004).

One threat to validity were differences in the modes of retrieval, i.e. mobile ECMO, conventional or conventional to mobile ECMO. The decision was taken to obtain data for all those retrieved irrelevant of the mode of retrieval at the same three stages of the patient journey. The groups were not compared to each other due to the differences in size. The study was limited in terms of the number of patients available for sampling decreasing statistical power and the lack of a content validity index. As a sole researcher, time and resources were limited, and the data collection tool was only used by me as therefore not subjected to assessment by other researchers.

Validity concerns can also arise from inaccurate or incomplete data or case-mix bias (Worster & Haines 2004), as the method is reliant on the nature of the data available, which can reflect the skills and experience of those undertaking the documentation (Rask et al, 2010). In six cases there were incomplete notes and documentation, so they were rejected from this study. Documentation such as history taking and recording may be subject to the clinician's own personal subjectivity and diligence, which needs to be acknowledged when designing the data collection tool as stated by Rask and colleagues in 2010. However, they note that rather than detract the value of MRR, it is more a reflection of the actualities of influences in the 'real world'. Eastwood et al (2009), advise caution in making inferences or assumptions due to these external influences. Although they did conclude in their study that there was sub-optimal delivery in the ICU, this did not necessarily relate to patient

care, and other factors such as staffing and skill mix, not significantly documented, also need to be considered.

Overall, overcoming these limitations of the measurement properties requires a great deal of preparation both for the data collection tool and the reviewers, although MRR does remain a research method that yields valuable data which aims to raise awareness and impact on clinical practice to improve care (McConnell-Henry, 2015).

The measures described were utilised to maximise the study design in terms of validity and reliability. It is important to note that they are interlinked, and research should aim for degrees of rigour rather than an absolute value as each study is only related to a specific purpose and context and as such should be critiqued with that in mind (Boslaugh & Watters, 2008).

4.2.7. Ethical approval and access to medical records data

The moral principles that guide researchers pertaining to treat participants fairly and responsibly throughout the research process are known as ethics (Williamson, 1981). Following the *unethical* Tuskegee Syphilis Study (1932- 1972) the recommendations made by the Belmont Report (1978), summarizes ethical principles and guidelines for research involving human subjects. Three core principles are identified: respect for persons, beneficence, and justice. Three primary areas of application are also stated. They are: obtaining informed consent and protection of vulnerable people from coercion; assessment of risks and benefits; and selection of subjects. Health research ethics committees monitor adherence to ethical principles laid down in the Nuremberg Code (International Medical Tribunal 1948), and the Declaration of Helsinki (World Medical Association, 2008). This applies to both retrospective survey data or patients, and in-depth interviews with nurses. In addition, as a registered nurse the United Kingdom Nursing and Midwifery Council (NMC), has a code of conduct (NMC, 2018), that must be adhered to whether in the role of a professional nurse or as a researcher. Of relevance are: respect and uphold people's human rights; respect people's right to privacy and confidentiality; and act without delay if you believe there is a risk to patient safety or public protection (NMC, 2018).

Approval was sought to collect and analyse medical records data through the formal Integrated Research Application System (IRAS). This was successful and the study gained the approval from the Health Research Authority approval (HRA), the NHS Research and Development (R&D), and ethical approval from the NHS Trust concerned and from the University of De Montfort (see Appendix 10). With support from the Research Innovation Team at the NHS Trust base a feasibility review was undertaken and consent training completed. In compliance with the NHS Trust Information Governance Policy the clinical manager for ECMO was also approached to seek permission for the medical records data. It was made clear that admission to ECMO also entails possible use of patients' notes for audit or research purpose, through the patient information leaflet, and discussed by the Consultant when seeking assent for ECMO treatment from the next of kin.

No identifiable data was extracted from patient notes and records in SPSS are only identified by a number. Once the information was extracted from the relevant documentation it was returned to Patient Records. All Information was treated confidential, and anonymity maintained. The data was entered onto an SPSS package on a password protected computer. Paper records were kept in a locked office to ensure that data protection was maintained. Adherence to the Information Security Policy at the Trust (DMS No 12212), and the Data Protection Policy (DMS No 11800), and Caldicott guidelines were always adhered to (DOH, 2013).

The next section looks at Phase II, the grounded theory interviews and analysis.

4.3. Phase II: Grounded Theory Analysis

This next section describes the grounded theory analysis, outlining the research setting, the grounded theory interviews, sampling of participants, data analysis and coding, memo writing, ethical principles, reflexivity, and rigour.

4.3.1. Research Setting

The research was situated within the AICU at the base hospital. The transport team involved in the retrieval of critically ill adults comprises an ECMO doctor, a transport nurse, and if a mobile ECMO retrieval, a perfusionist is also present.

The nursing transport team comprises of six permanent members of the ECMO team, and seven non-permanent transport team members. The latter were based at Glenfield, and also part time ECMO specialists. The transport nurses are registered nurses at Band 6 level or above, and have attended a one day in house 'Transport of the Critically Ill Adult Course'. The permanent ECMO team in addition have attended a one day in house 'Mobile ECMO Transport Course'. Allocation of staff for conventional transport is primarily sought from the ICU to provide a transport nurse. There is no official roster or on call system. Due to skill mix and workload this facility is not always provided, and two options are then explored. Availability within the permanent ECMO team is sought, if unsuccessful, then contact with off duty staff is sought. This is on a voluntary basis, and staff are financially remunerated. Allocation of staff for those patients that may require mobile ECMO is restricted to the permanent team at present.

4.3.2. Grounded theory interviews

An interview can be defined as a directed conversation (Lofland & Lofland, 1995) and has been used extensively in qualitative research as a data-gathering tool. Intensive interviewing is apt in interpretive inquiry as it allows an in-depth exploration of a particular phenomenon by eliciting the participant's interpretation of their experience(s). It enables the researcher to understand a topic, while also acknowledging that the participant has the relevant experience to be able to illuminate the topic (Seidman, 1997), through asking them to describe and reflect in such a way that they wouldn't ordinarily undertake (Charmaz 2006). The interview becomes contextually situated and also negotiated so that it reconstructs, but not reproduces reality as perceived by the interviewee, and gives the interviewer different accounts from different points of view of the same phenomenon (Charmaz, 2006). Grounded theory interviews depart from the more traditional qualitative interviews in that although they are open-ended, unrestricted, and free-flowing, they are also directed and emergent. The focus of the interview topic becomes more specific and narrow through succeeding

interviews acquired from developing theoretical frameworks, rather than gathering the same data in each interview (Charmaz, 2006). It can be argued that interviewers and observers are equipped with blind spots, and decisions have to be made in the light of the particular circumstances and purposes of the research (Hammersley and Atkinson, 1985). For this study, access to the correct interviewees for ascertaining a picture of a patient's journey through referral, transport and ECMO was readily available on the proviso that consent was obtained. The use of memos in the grounded theory interviews also enables the researcher to suspend thoughts, feelings and preconceptions, and as an aid to reflexivity (Birks and Mills, 2015).

4.3.3 Sampling

In any qualitative research the key to the development or construction of thorough and powerful theory is through the astute use of efficient sampling. The essence of grounded theory analysis is due to the insight of the investigator and requires conceptually small amounts of data, which is significant, relevant and informative, not irrelevant or tangentially significant to avoid not only fatigue but conceptual blindness (Morse, 1991). Therefore, by necessity there is an inherent bias in selection, and random sampling is to be avoided as 'best cases' are needed to produce saturation of categories within the data needed to ensure replication and validation. As a process grounded theory sampling commences purposefully with participants situated in the actual context. This occurs when the participants are selected on the criteria of accessibility and advocated at the beginning of the research in order to identify the: scope; range; boundaries; trajectory; and stages of the process (Morse, 1991). The transport nurses were selected as they work within the context that is being explored, and whom the researcher anticipated could offer insights into the study area (Glaser, 1978, Glaser & Strauss, 1967, Charmaz 2014). This is to fulfil the aim of an explanatory theory that explicates the phenomenon from the context and perspective of those who participate in it. Participants are selected to provide thick descriptions of the situation, the quality of which is thought to rise exponentially if the participants are 'experts' in the phenomenon under investigation (Morse, 1991). At this stage of purposeful sampling the actual number of participants are not known.

This initial purposeful sampling provides the starting point only for the researcher. Engagement with the data generated from the first participant, and the process of analysis, highlights further issues that need clarification, expansion and/or confirmation (Birks and Mills, 2015). The next process of sampling is theoretical sampling. This occurs after reflection from the purposeful sampling

which directs the researcher to seek participants who can aid and elaborate on concepts already forming, thus adding to the existing data (Birks and Mills, 2015). Diversification can occur at this stage by seeking other sources or types of data (Birks and Mills, 2015). There follows a cycle of re-interviewing existing participants, or recruiting new, using constant comparison technique (Figure 4.3)

This process continues until the penultimate stage which is the theoretical group interview. Presenting an overview of the ongoing analysis to the group of participants allows resolution of ambiguities or addressing gaps in the emerging theory. This enables the phenomenon under study, through utilisation and adaption of efficacious sampling (Birks and Mills, 2015). Sampling continues until the notion of theoretical saturation is reached. Glaser & Strauss (1967), identified this as the point where no new codes are identified from the later cycle of data generation and the researcher experiences similar characteristics across and within incidents (Charmaz, 2014). At this point, the emergent categories will also be conceptually developed enough that any subcategory, or themes, can be understood and identified and integrated within the data (Birks and Mills, 2015).

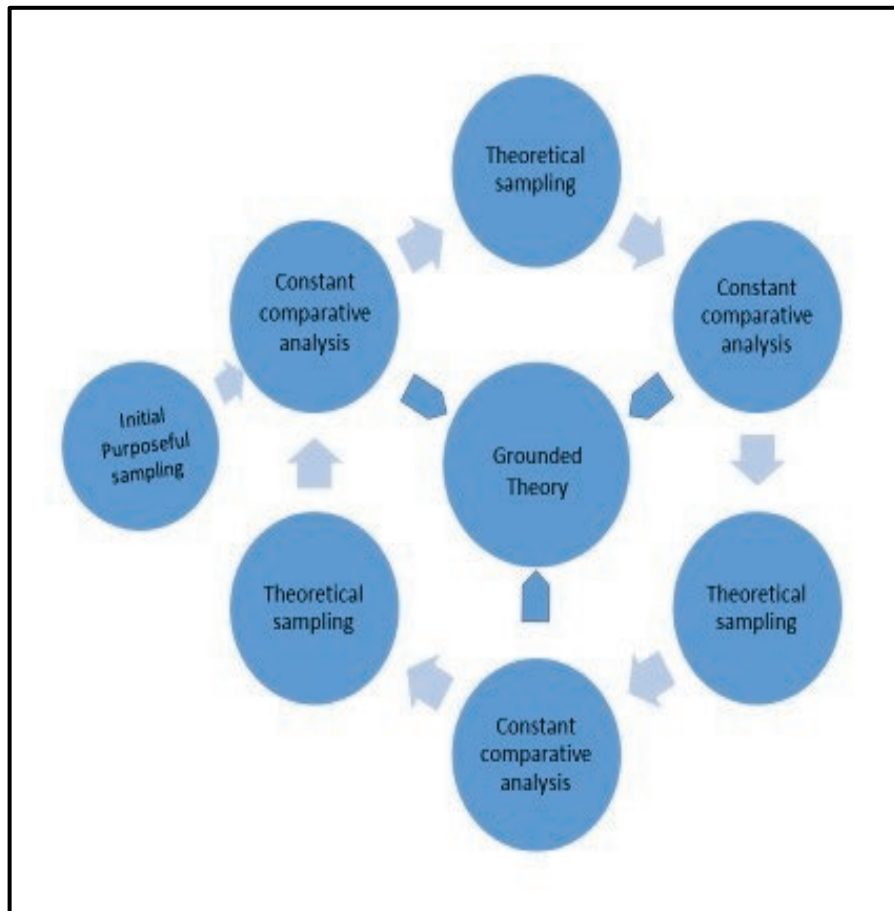


Figure 4.3. Theoretical sampling (Birks & Mills, 2015)

Inclusion Criteria:

- Registered nurses in an NHS Intensive Care Unit, possessing a valid NMC registration, Band 6 and above.
- Those directly responsible for the care of the patient being referred and transported.
- Is a permanent member of the Adult Intensive Care Unit or the ECMO team at the base unit.
- Is no relation to the patients or researcher.
- Gives informed consent to the interview.

Exclusion Criteria:

- Band 5 qualified nurse
- Transfer between hospitals other than the base unit.

A total of six nurses were interviewed with data analysis between each interview. This gave a total interview time of 18 hours and 45 minutes of interviews, upon which no new categories could be identified, and therefore theoretical saturation was reached. Three of the nurses were re-interviewed after initial data analysis to provide clarification. Re-interviewing participants can be used in grounded theory as an aid in developing and processing theoretical development (Birks and Mills, 2015). Memos were used as an aid to reflect, maintain neutrality, and form a documentary process of theory development.

Length of experience and pseudonym is shown in Table 4. 2.

Pseudonym	Background	Length of Time in Intensive Care	Transport Training
Anna	Paediatric Intensive Care Permanent Member of ECMO Team	33 years	PICCTS STACC Mobile ECMO
Claire	Adult Intensive Care Part Time Member of ECMO Team	16 years	STACC
Francis	Paediatric Intensive Care Permanent member of the ECMO Team	27 years	PICCTS STACC Mobile ECMO
Ellie	Adult Intensive Care Part Time member of the ECMO Team	11 years	STACC
Linda	Adult Intensive Care Permanent Member of the ECMO Team	37 years	PICCTS STACC Mobile ECMO
Penny	Adult Intensive Care Permanent Member of the ECMO Team	21 years	PICCTS STACC Mobile ECMO

Table 4.2. Experience and pseudonym of interview participants

4.3.4. Data Analysis and Coding

Coding is a central analytic procedure in grounded theory, and terminology can vary according to the language used by different grounded theorists (Birks and Mills, 2015). The purpose of grounded theory analysis is to identify and progress concepts (descriptive or explanatory ideas) (Holloway, 2008), that are initially of low level, and elevate them to a higher level of analysis throughout the process (Birks and Mills, 2015). This results in low, medium, and high level concepts through conceptual ordering (Corbin and Strauss, 2008). The process commences with generating initial codes or 'open coding' (Glaser, 1978), using line by line coding of the interviews, to underlying recurring incidents, characteristics, phases, explanations or ideas. These concepts were further explored through an iterative process, across the interviews to identify similarities and reoccurrences, and merge in a higher level of analysis to form a category. This often reflects the language of the data and are termed substantive codes (Glaser, 1978), or *gerunds*, coding of data as actions (Charmaz, 2014). This iterative process continues with codes being compared to codes, to verify their adequacy and highlight those that make more analytical sense, and direct theoretical sampling. This form of coding fulfils two main edicts of grounded theory: fit and relevance (Charmaz, 2014). Constant comparison of subcategories and categories leads to the generation of a core category, at the highest level of analysis that encapsulates all the actions, thoughts and processes within the sub categories and categories.

Once transcribed the interview data was printed on the right-hand side of the paper to allow for initial concepts, and open coding that reflects actions in the data (Charmaz, 2014). Theoretical sampling was employed, aided by the use of memos as the codes become more focused, selective, and conceptual to synthesise and explain larger segments of data. In this way, initial codes crystallised into categories reflecting the participants' experiences, and enabled a relevant analytical framework that reflected the interpretations and processes underlying the participant's reflection of their world. The use of memos was employed at all stages to aide memoir the emergent codes, categories and theory.

4.3.5. Memo Writing

Memo writing is a crucial process within grounded theory providing a link between data collection and writing drafts. In the initial stages the memo can not only record what is happening in the data but can be used to explore the emerging codes and enable direction towards further data collection (see Appendix 11). It allows theoretical cogitating and a degree of playfulness in its focus not only on words and actions, but also to become aware of assessing what social processes are going on through constant engagement with the data (Charmaz, 2014) in the coding process, as certain codes stand out and become the embryonic theoretical categories, the memo allows crystallisation of thoughts, projects new ideas and maintains evidence of the constant comparative process in grounded theory. It also provides somewhere to place preconceptions and ideas and enunciate any sensitising concepts that otherwise may not be overt. In the latter stages of the grounding process it facilitates description of how the category emerges, and the belief framework and social processes supporting it, and allows you to consider the category from several vantage points to refine the theory before drafting it (Charmaz, 2014).

4.3.6. Reflexivity

Quantitative methods arise from established or existing theories using rigorous terms that are unaffected by the variables of social change, economics, environment, politics, and culture. These variables, however, do exert their influence on qualitative methods and the context from which where qualitative theorists first interpret and then define their concepts (Mruck & Mey, 2007).

One example of this is grounded theory itself – which has evolved subject to academic trends, promotion and acceptance of qualitative methods, and social and political awareness, and it is also subject to inconsistent use by the heterogeneity of researchers.

The ‘humanness’ of researchers, their alliance, their methodological language, also applies to those being researched as their descriptions (verbal or otherwise) are grounded in everyday language and context. Thus, it can be argued that qualitative methods are subjected to inferences that make their methods less rigorous to assess, examine, and evaluate than those of quantitative

methods. This position places an emphasis, therefore on the needs of qualitative theorists to make overt, even transparent, particularly within grounded theory, the methods used. There is a requirement to ensure that whoever reads the research understands the rationale for the methods used, the procedures used, and can demonstrate the evolvment of the grounded concepts into theory (Mruck & Mey, 2007).

Each grounded theory arises within a certain time period, place and a specific context, within which the researcher belongs. In the objective of attaining a degree of methodological certainty then the researcher needs to acknowledge their own assumptions, and beliefs through a process of self-critical awareness (or reflexivity) (Mruck & Mey, 2007)

This is not a contemporary thought but one that became more prominent with the 'enlightenment of self' (Lynch, 2000, p20), and further elaborated through the so-called 'crisis of representation' (Tedlock, 2000). There was a drive for culturally co-constructed writings to undergo a reflexive stance (Mruck & Mey, 2007). There followed varying interpretations of 'reflexivity', and proponents of different types of reflexivity (Lynch, 2000), but central to the idea of reflexivity in all its forms is the ethos of 'turning back on one's own experience' (Steier, 1991, p2). The actual way this is done differs according to the issues of the research, the methods used, the discipline involved, and epistemological and theoretical stances (Mruck & Mey, 2007).

Within grounded theory, reflexivity is important as theory development depends on the participants involved. The researcher therefore needs to explicate and acknowledge prior and tacit knowledge, provide information about the conduct of the research, their interaction with the research participants, and communicate how this may have affected theory development (Mruck & Mey, 2007). Through this process of reflexivity, the criteria to meet the need for rigour in qualitative research of enhancing trustworthiness, credibility, transferability, confirmability, dependability, and authenticity (Lincoln & Guba, 1985), are also met.

Reflexivity, reflecting critically on the self, analysing and making notes of personal values (Polit & Beck, 2014) was conducted through all the stages of the grounded theory, starting with the initial research question and deciding on the design of the study. The research question arose following a critical incident of enough emotional and professional magnitude to make me stop and think 'what is happening here?'. I had spent many years in critical care with numerous transport experiences, both good and bad, aware that each transport brought a new lesson to be learnt, albeit usually on a more routine scale. At this time, I had also built bridges into academia, teaching in various universities, utilising my prior academic skills combined with practical knowledge in delivering evidence-based practice. The contacts I had made in the academic field led me to believe that is what possible to find out "what was happening here? ", through conducting research for a Doctorate in Health Sciences.

As with any study, the political and economic environment does not change while you are pondering how to conduct your research. Initially, the focus was upon doing a case study at the base hospital, but this was negated when the Government in response to the H1N1 pandemic commissioned four further hospitals as adult respiratory ECMO centres (DOH, 2010). The study design then became one of mixed methods using both quantitative data obtained from patient's medical records and qualitative data from interviewing transport nurses. There were time and financial constraints which impacted on me as being a single researcher and the study design had to reflect the resources available. Working in the base hospital allowed me to be familiar with the logistics of retrieving medical records, and access other transport nurses once ethical approval had been obtained. I was overwhelmingly aware that the transport nurses I would be interviewing were also my colleagues, and that I needed to acknowledge my personal and professional experiences and thoughts to prevent any bias, influence, or coercion in the interviews. This insight was also useful when determining ontological and epistemological choices that could now be made with a more enlightened viewpoint.

Preparation for the interviews commenced after a period of consolidation of knowledge acquired through reading various tomes about grounded theory interviews. I was excited to hear from my colleagues and see the transport through their eyes but was also apprehensive regarding the situation of myself as researcher versus myself as transport colleague/team member and tried to maintain a dual personality for a while. The invitation to participate in the research was even posted

into their pigeonholes at a time when no one was around to see me! The sampling design was to invite all members of the transport team to participate, both full time and part-time members, and assent was obtained through the response to my invitation. Purposeful sampling was used, although all the transport nurses met the criteria of being situated in the actual context, were able to offer insights into the study area, and had comprehensive critical care and transport skills. The interviews were intended to be conducted at the base hospital in an environment familiar to both the researcher and the interviewee. Familiarisation with the environment, its routines in terms of noise, time of day, clinical care, and pressures on the transport nurse, were of benefit in allocating time and space for the interview, aided by a good rapport and understanding of the nurse managers involved to facilitate the interview. However, the reality of critical care nursing became apparent as 2 nurses were required to work clinically, and one nurse was sent out on transport! Two interviews were then conducted in the participants' home, and although not familiar with the environment, I was becoming more experienced in interviewing and the participants were themselves relaxed. The last initial interview was conducted over the telephone. I did miss observing the body language but as I knew the participant this was not a detraction from the interview narrative.

As per grounded theory method, the first interview took place, was recorded, and then transcribed. I found that on listening to the recording that I interrupted the flow of conversation frequently, and interfering or momentarily halting the narrative. I then had to get the interviewee back to the moment that I interrupted. On reflection, I found that I was interrupting when her thoughts and words sparked an agreement with mine, and the attempt to suspend my own thoughts and presumptions was minimised by a desire to let the interviewee know that I was in agreement. The balance between mutual agreement, reciprocity, and equal positions of power were being deviated by my interjections and the possibility of me overtaking control of the interview.

While as a researcher but also a transport nurse, I shared an understanding of the key issues discussed, this relationship was also at risk in trying to dominate the interview. It was a sharp lesson to learn about interviewing and reflection and was one of my very first memos. Putting this aside, I then concentrated on interrogating the narrative obtained. The next interviews were more free-flowing and only interrupted for clarification and elaboration. I was soon able to discern those who used the interview as a 'megaphone' to communicate (Mruck & Mey, 2007). Even though the interviews were different in style, each pertaining to the individual personality interviewed, there were

common phrases and ideas amongst them. I spent a great deal of time analysing the narratives, making notes on the paper, making comparisons, trying to find themes or recurring concepts.

Eventually, I wrote the first draft in relation to the quantitative data obtained. To my dismay, my supervisors felt that I was trying to 'fit' my data around the quantitative results, and along the timeline of the patient journey, that is imposing a pre-existing framework. I had made the classic error of trying to 'force' the data instead of letting emergence of theory (Glaser, 1992), and inhibited any ideas of theoretical sensitivity. I then re-immersed myself in the data using the grounded theory decree of 'study your emerging data' (Glaser, 1978), putting the audiotapes on in the car, and simply listening to them first without making notes. In this way, my own preconceptions also became subsumed under the constant exposure to the interviewee's words. I was forced to rethink my original method of coding, scrapped it all, reprinted all the narratives and started again.

I recommenced line by line coding but recognising that I needed to be more critical and analytical using questions propounded by Charmaz (2006, page 127), to gain insights into the data. This progressed line by line coding into initial concepts and using A3 paper, memos and notes, which reflected the state of the grounded theory interviews at this stage (Appendix 11). A mental block then occurred, although comparisons were found between narratives of initial concepts the progress through to more focused codes was hindered by my inability to project them and harness them together. Back to the tomes on grounded theory and a light bulb moment when I rediscovered the use of gerunds 'verbs used as nouns always ending in 'ing' (Birks & Mills, 2015, p178). The application of gerunds propelled initial concepts into codes through to sub categories, and with this came a need to re-interview and clarify these concepts and ideas to establish them, or ground them more firmly. At this point then theoretical saturation occurred. What was missing now was the theoretical framework that might prove to link these findings together and elevate them from description to related hypotheses to be integrated into a theory.

The idea of fostering came from an overall impression that for a short period of time, the transport nurses were 'adopting' the patient, albeit temporarily, which led to the use of the term fostering. On exploring the concept of fostering I realised that the process of fostering exhibited several similarities with the process of transport, and that foster carers shared similar characteristics in terms of skills sets required, development, documentation, team working, and the demands made upon them with nurses. It was here that I discovered the Secure Base Model (Beek & Schofield, 2004).

The transport nurse's engagement with technology led to consideration of the debate between technology and caring but did not explain the concepts surrounding the drive, passion, and belief in undertaking transport and ECMO. The Actor-Network Theory was discovered while exploring literature on humans and technology. The application of this theory to the codes and sub categories of technology provided a link to an extant theory that gave explanations for the behaviour of the transport nurses, as shown in the memo in Appendix 11. From here, the Secure Base Model from fostering, and the Actor-Network theory, worked together to make overt the transport nurses thoughts and actions in caring for a patient over time, driven by and with technology to maximise their ability to optimise a patient in transport. Linking the two together through gerunds produced a core category and a substantive theory. Presentation of the findings were presented first to the transport nurses interviewed in a group setting. The overall view was that they were quite surprised at the amount of work they did when it was made overt and presented to them. The second and third presentation were to two central transport services for paediatrics, due to lack of adult regional centrally co-ordinated transport teams. The feedback was overwhelmingly that they could relate to, and find similarities with, the concepts and categories presented, which provided reassurance that some degree of verification had been attained and that the overall substantive theory could also be applied to paediatric transport.

The challenge of reflexivity, suspending one's own presumptions and beliefs, ensuring the participants beliefs and not my own were projected, and the emergence of theory was achieved through a series of strategies. Familiarisation with the environment, the transport process, and the jargon used in interviews allowed an insight that an external researcher may not achieve. Reciprocity at interviews was only achieved by careful listening to my behaviour at the first interview and adopting a partnership approach at subsequent interviews. Making the mistake of forcing the data and minimising theoretical sensitivity cost time, but reimmersion into the narratives and going back constantly not only to the data, but also to grounded theory literature proved to be invaluable. The use of memos, note pads, and A3 paper proved to be vital in laying out ideas and concepts, and the use of gerunds and imagination were key events in linking codes with categories. Exploration of literature not directly related to the subject area led to the Secure Base Model and the Actor-Network Theory.

The use of reflexivity is, therefore, not only useful to the researcher but is invaluable in making overt the qualities of the research by which the notion of rigour will be interpreted. The next section discusses the notion of assessing quality in grounded theory.

4.3.7. Assessing quality in grounded theory interviews

The focus of assessing quality in qualitative research and analysis is that the interpretations and results should be made transparent and comprehensible (Flick, 2009), and relies on whether the researcher has adequately documented the approach used to analyse the data (Polit & Beck, 2014).

The debate on applying quantitative standards of data evaluation to qualitative data was decreased with the introduction by Lincoln & Guba (1985), of four and then later five parallel standards of reliability and validity in qualitative research. These were credibility, dependability, confirmability, transferability, and authenticity.

Credibility is achieved to the extent that the research methods inspire confidence that the results and interpretations are truthful and accurate (Polit & Beck, 2014). Confidence in the truth of the data is enhanced by designing the study to heighten the credibility and believability of the findings, and then overtly taking steps to demonstrate this to readers of the research (Polit & Beck, 2014). Documenting the analytical process is key to providing information about the study design. This chapter has presented the design of the study in the research methods of qualitative grounded theory interviews. Together with reflexivity throughout the journey this has demonstrated data generation through purposeful sampling, interviews and lessons learnt, the method of transcription of the narratives and theoretical saturation of data. Triangulation with quantitative data, to enhance credibility is shown in chapter 5. The use of memos' and peer review and debriefing has been discussed in reflexivity, together with an honest assessment of the stages through the research journey. These are all strategies to enhance the credibility of the research findings.

Consideration of the stability of the data over time and context is referred to as dependability (Polit & Beck, 2014). It is enhanced through documentation of decisions made (in reflexivity), and member checking, which was obtained. Presentation of the research findings to the paediatric centralised transport nurses showed that they both recognised the themes and categories within the qualitative findings, and reported similar situations and circumstances. Although this is a single study

in a specific context, the study design could be applied to other transport centres and should be utilised in the future. It is to be noted that the findings do only concern themselves with transport nurses and research on other members of the transport team in different roles may result in different data being presented.

Establishing that the data represents the information provided by the participants and reflects their voice, their interpretations situated in their context, as opposed to those of the researcher is the aim of confirmability (Polit & Beck, 2014). It entails the researcher acknowledging their own feelings and perspectives, but not allowing these to influence or bias the research. The use of reflexivity and memo's enables the researcher to decrease the possibility of this happening. Presentation of the research findings to those involved in this study found that they did reflect their views.

In qualitative research the aim is not so weighted to generalisability of data, but rather to generate knowledge that may be useful in other situations and contexts, particularly in evidence-based practice (Polit & Beck, 2014). The applicability of the findings and their transferability relies on the researcher providing enough descriptive data that can be externally reviewed as to the suitability and practicality of it being transferred to other contexts. This can be enhanced also through making overt study design, memo's and thick descriptions.

Finally authenticity represents the ability of the research to demonstrate not only the lived experience of those researchers, but they are able to gain a flavour of the feelings, the experience, the context of those being researched, and experience a range of different realities (Polit & Beck, 2014). With authenticity then comes heightened sensitivity and understanding of the researched arena and phenomenon. Thick description, memoing, reflexivity, and faithful transcription of narratives are important steps in achieving a degree of authenticity.

In order for qualitative research to be critiqued it relies on being both transparent and comprehensible (Flick, 2009). Documenting and making overt a decision trail for the method used, sampling, data collection, and data analysis, using memo's and reflection, allows other researchers and readers to evaluate the elements of trustworthiness of the research findings. Providing rich, faithful and accurate descriptions, together with triangulation of other data sources

also allows the possibility of replicating the research in other contexts and provides an insight into the authenticity of the research. As with quantitative data, these elements are interlinked and are not absolutes but vary in degrees. Strategies to optimise trustworthiness have been outlined to promote transparency and clarity.

4.3.8. Ethical considerations

The University of De Montfort Ethics Committee (FREC) approval was given (HLS FREC 1191), and the University Hospitals of Leicester NHS Trust Ethics (UHL 11350), through the Integrated Research Applications System (IRAS).

Each nursing member of the team who had partaken in retrieval of a critically ill adult was given a Participant Information Sheet, and Consent form in a sealed envelope in their internal mailboxes situated on a separate corridor to AICU (Appendix 12). They were asked to return the form within four weeks to allow for annual leave or sickness. During this period conversation was kept to professional or social aspects within the team, any queries regarding the study were dealt with in a quiet room away from the main AICU. If there was no contact, then refusal to take part in the research was assumed. There were no identifying marks on the envelope or consent form. There was no coercion or obligation at any stage of the process. Participants have a right to confidentiality and anonymity and to give informed consent regarding participation and to be aware participation is voluntary. Anonymity was guaranteed and no names would be used in the final report, or indeed any information which could identify participants.

If signed consent was provided, then an interview was scheduled to take place at a time and place of the candidate's choosing. Interviewees were offered face to face or telephone interviews. One interview was conducted over the phone, two interviews were conducted in the candidates own homes and the rest were undertaken at work in a quiet, private place away from the patients, and having provided nursing cover, if needed, for the interview to focus attention and avoid unnecessary duress. There was no time limit to the interview, aside from 5 – 10 minutes to be spent in going over the consent form, answering questions and explaining the IC recorder. The interviews were audiotaped using a voice activated mode on a Sony IC recorder ICD PX 240 in agreement with the respondent. The issue of the researcher also being a nurse and familiar with the sample population was taken into consideration. The ethics pertinent to this situation, was guided by the 3 basic

principles suggested by Holloway & Wheeler (1995): mutual respect - understanding aims and interests, not harming self-esteem and not being condescending; non- coercion and non - manipulation - not using force or threats or leading others to co-operate when it is against their interests; and support for democratic values and institutions and a commitment to equality and liberty. These were important prior to the interviews as the notion of autonomy arose. The ability of individuals to make reasoned decisions i.e. autonomous decisions, could impact on the research study. If a colleague were to refuse to consent to being interviewed, the researcher has to respect their wishes and decisions, and alleviate any issues if able.

4.4. Chapter summary

This chapter has introduced the study design applied to the grounded theory study, which comprised of two phases, phase I the use of the Medical Records Review, and phase II the grounded theory interviews. MRR was introduced and the rationale for its use discussed.

The data collection tool was formulated and the sampling plan for the participants stated. Data analysis was then described following by assessing the quality of quantitative data. Ethics pertaining to the participants in phase I was documented. The introduction of phase II the grounded theory interviews and analysis was setting the scene for the data collection and analysis. The nature of the interviews was outlined and purposeful sampling pertaining to grounded theory was discussed. The next section dealt with the nature of data analysis and coding in grounded theory, following on from the initial introduction to this topic in chapter 3. Assessing the quality of qualitative data encompassed the use of memos, reflexivity, and consideration of trustworthiness. Ethics pertaining to the transport nurses participating in the study was then stated.

The next chapter, chapter 5, presents the results of the MRR and the grounded theory analysis of the unstructured interviews.

5.0. CHAPTER 5: RESULTS AND DISCUSSION

5.1. Introduction.

Seeking answers to questions is rarely as straightforward as anticipated, and surprises may prompt alternatives to be explored. The critical incident outlined in chapter one focused attention on patient acuity and physiological changes over the duration of the transport process, with the aim of learning from such incidents to provide a more stable and optimal journey for the patient. The literature review of quantitative data reinforced the vulnerable instability of the acutely ill adult (Droogh et al, 2012), and that changes did occur physiologically during transport (Wiegersma et al, 2011), although few studies showed a statistically significant deterioration (Ligtenberg et al, 2005).

The quantitative results are presented in relation to the patient journey, to provide holistic picture to the context and situation for the role of the transport nurse maintaining patient stability. The concept of stability cannot be understood without knowing or appreciating a baseline picture of the patient. The demographics provide an overall picture of the sample population, and a baseline is established by the physiological profile of the patient on referral. This baseline is then compared to the next two time frames, which were: on arrival at the referring hospital; and immediately prior to commencing ECMO. Pre-transfer preparation of the patient, shown to be a factor in maintaining patient stability (Ligtenberg et al, 2005, Flabouris et al, 2006), is then presented in data collected pertaining to: the advice given to the referring hospital at the time of referral; and the nature and type of interventions undertaken by the transport nurses both at the referring hospital and on the return journey. To complete the picture the outcome of the sample population is then presented. The grounded theory results are then presented to give an in depth picture of the transport nurse's thoughts, feelings and activities, throughout the transport journey, informing the emergence of the core category, through integrating sub categories, emerging from initial open coding and constant comparison.

5.2. Quantitative results.

5.2.1. Patient Demographics

The overall demographics of the sample population (n = 50) obtained by random sampling are shown in Table 5.1:

Demographic	Range	Mean	Standard Deviation
Age in years	18-72	44.94	14.22
Sex: Male Female	29 (58%) 21 (42%)		
Weight in Kgs: Male Female	50 – 125 50 – 115	81.20 73.10	18.40 15.30
Hours intubated at the time of referral in hours	2 – 297	53.69	64.51
Ethnicity: White Black Asian Other	86% 8% 4% 2%		
Primary Diagnosis: Pneumonia ARDS CAP Legionella Pneumonia Asthma Aspiration Pneumonia Malaria Pneumonia	40% 18% 18% 14% 4% 4% 2%		

Table 5.1. Demographics of the sample population.

The data showed three areas differed from the national average (Office for National Statistics 2011):

1. The national average of male to female distribution is 49% and 51% (ONS, 2011) respectively compared to 58% and 42% in this study.
2. There were higher numbers of patients of African descent (8%), compared to the national average of 3.01% (ONS, 2011), and less Asian ethnicity in the sample population (4%) compared to 6.92% in the national average (ONS, 2011). Ethnicity differences in critical illness can reflect a mix of social, cultural, environmental and economic factors in aetiology (Barnes, 2004). Advances in technological testing for genetic influences in Acute Lung Injury, showed that it can occur more frequently in people of African descent (Barnes, 2005).
3. Weight deviated from the national average which showed an average for females of 70.0kg (ONS, 2011), compared to national average of 74.0kg. In males the ONS (2011), showed an average of 88.6kg, whilst the sample average was 81.2kg. Previous studies have shown a similar variation from national statistics (Durairaj et al, 2003, Ligtenberg et al 2005, Wiegersma et al, 2011).

Hours intubated at time of referral showed the range of time that the patients spent in the referring ITU from 2 hours to 297 hours (mean 53.69 hours), before they were referred for consideration of ECMO.

5.2.2. Physiological profile of the Patient

Eight physiological parameters were collected for each patient, at three time frames. The rationale for the choice of variables (chapter 4), provides information regarding the patient severity. The results are shown in Table 5.2.

Parameter (Normal Values)	Range	Mean	Median	Standard Deviation
Hb (10 – 14 mmHg): On referral Arrival of transport team Pre ECMO	7.1 - 15.8 8.2 - 15.8 8.1 - 15.7	10.80 10.60 10.50		1.62 1.80 1.77
PH (7.35 – 7.45): On referral Arrival of transport team Pre ECMO	7.0 - 7.5 6.9 - 7.48 6.8 - 7.49	7.21 7.20 7.17	7.21 7.19 7.17	0.12 0.14 0.17
PaO ₂ (10 – 12 kpa): On referral Arrival of transport team Pre ECMO	4.0 - 15.0 3.1 - 35.5 5.0 - 33.0	8.64 7.20 7.17	8.15 8.86 8.30	2.22 4.71 5.22
PaCO ₂ (4 – 6 kpa): On referral Arrival of transport team Pre ECMO	4.3 - 16.5 4.0 - 15.5 4.6 - 25.9	8.50 8.80 9.15	8.70 8.80 9.15	2.49 2.45 4.46
PaO ₂ /FiO ₂ ratio: On referral Arrival of transport team Pre ECMO (Mild 201 – 300, Mod 101 -200, Severe <100)	40 - 242 31 - 353 31 - 344	94.9 98.2 77.9	91.0 90.0 62.3	35.9 51.8 28.7
Lactate levels (0.5 – 1.0 mmol/l): On referral Arrival of transport team Pre ECMO	0.4 - 11.9 0.4 - 12.7 1.0 – 13.0	2.50 2.98 3.36	1.60 2.05 2.40	2.30 2.81 3.38
MABP (60 – 80mmHg): On referral Arrival of the transport team Pre ECMO	50 – 98 48 – 112 35 – 105	74.0 75.5 73.2	75.0 75.0 74.0	10.77 13.94 16.02
Adrenaline dose (mcgs/kg/min): On referral (n=6) Arrival of the transport team (n=12) Pre ECMO (n= 12)	0.021 - 0.700 0.030 - 0.280 0.038 – 0.280	0.290 0.128 0.128	0.250 0.100 0.100	0.280 0.078 0.081
Noradrenaline dose (mcgs/kg/min): On referral (n=42) Arrival of the transport team (n=42) Pre ECMO (n=39)	0.02 – 3.00 0.02 – 2.20 0.018 – 2.26	0.410 0.420 0.420	0.350 0.335 0.315	0.495 0.424 0.444

Table 5.2. The physiological profile of the patients at three time points.

Over the three time frames, the mean values of the PH shows a worsening acidosis, together with a rise in mean PaCO₂, and a decreasing PaO₂/FiO₂ ratio, together with a rise in lactate levels showed the patient was deteriorating with worsening ARDS and accompanied acidosis. The MABP however stayed the same despite a decrease in mean adrenaline, although more patients were receiving it, and a very slight increase only in Noradrenaline levels of infusion.

5.2.2.1. PH Results

Table 5.3. shows the mean values and assessment of normality, using the Kolmogorov- Smirnov value, which indicates normal distribution as it was >.05.

NO =50	Point A (O/R)	Point B (O/A)	Point C (P/E)
MEAN	7.21	7.20	7.17
MEDIAN	7.21	7.19	7.17
S/D	.1256	.146	.167
Kolmogorov-Smirnov	.200	.200	.200
Chi square:	$\chi^2 (2 n = 50) = 11.62$		
Huyn-Feldt	Epsilon = .84		

Table 5.3. PH values over three time points.

The results show that although the PH levels did decrease over the three time frames the Ph levels did not differ significantly, $F = 1.35$, $p > .05$.

5.2.2.2. PaO₂ levels

Table 5.4. shows the mean values and assessment of normality using the Kolmogorov-Smirnov on PaO₂ levels shows violation of normality at Point A, therefore a non parametric Friedman test was used (Table 5.4).

PaO ₂ levels (n = 50)	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	8.64	9.45	9.71
Median	8.65	8.86	8.30
Mean Rank	2.00	2.02	1.98
S/D	2.129	4.71	5.22
K.S.	.200 *	.000	.000
Chi square: $\chi^2 (2, n= 50) = .046$ Asymp Significance: 0.977			

Table 5 4: PaO₂ values over three time points.

The result of the Friedman Test indicated that there was no statistically significant difference in PaO₂ between the three time points as $p = .977$). Inspection of the mean ranks shows a slight rise from Point 1 (2.00) to Point 2 (2.02), followed by a slight fall (1.98).

5.2.2.3. PaCO₂ levels

Table 5.5 shows the mean values and assessment of normality using the Kolmogorov-Smirnov where 2 out of the 3 time points showed violation of normality.

PaCO ₂ levels (n = 50)	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	8.5	8.84	8.36
Median	8.7	8.8	9.15
Mean rank	1.83	2.05	2.12
S/D	2.492	2.450	4.40
K.S.	.003	.200 *	.020
Chi square $\chi^2 (2, n = 50) = 2.588$ Asymp Significance .274			

Table 5.5. PaCO₂ values over three time points.

The result of the Friedman Test indicated that there was no statistically significant difference in PaCO₂ levels at the three time points Point A as $p > .05$. Inspection of the mean ranks show a slight rise from Point A to Point B, followed by another slight rise to Point C.

5.2.2.4. PaO₂/FiO₂ ratio

Table 5.6 shows the mean values and assessment of normality using Kolmogorov-Smirnov test. In this case normality was not assumed as all three time frames showed violation of normality.

PaO ₂ /FiO ₂ ratio (n = 50)	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	94.86	98.24	77.92
Median	91.0	90.00	62.30
Mean Ranks	2.43	2.27	1.30
S/D	35.94	51.82	53.85
K.S.	.003	.000	.000
Chi Square	χ^2 (2 n=50) =38.85		
Asymp Significance	.000		

Table 5.6. PaO₂/FiO₂ ratio over three time points.

The result of the Friedman Test indicated that there was a statistically significant difference in PaO₂/FiO₂ at three time points $p < .05$, as $p = .000$. Inspection of the mean ranks show a slight decrease from Point A to Point B and a larger decrease in Point C. As this result indicated a statistical significance, a Wilcoxon pairwise test was then performed to control for Type 1 error and also revising the alpha level for determining statistical significance to $0.5/2 = .025$ (Table 5.7).

Time	Result p =
Time 1 to Time 2 (on referral to on arrival)	.680
Time 1 to Time 3 (on referral to Pre ECMO_	.000
Time 2 to Time 3 (on arrival to pre ECMO)	.000

Table 5.7. Wilcoxon pair wise test for PaO₂/FiO₂ ratio over three time points

A Wilcoxon pairwise test revealed no statistical significance between the PaO₂/FiO₂ ratio between Point A (on referral) and Point B (pre ECMO) where p = .680. However, there is a statistically significant reduction in the PaO₂/FiO₂ ratio between Point A and Point C (p = .000), and Point B and Point C (p = .000), even allowing for the significance value to be reduced to .025. This demonstrates that the severity of the ARDS has significantly become worse during these time frames.

5.2.2.5. Lactate Levels

Table 5.8 shows the mean values and assessment of normality using the Kolmogorov-Smirnov test showing violation of normality.

Lactate levels (n = 50)	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	2.50	2.98	3.67
Median	1.60	2.05	2.40
Mean Ranks	1.71	1.95	2.34
S/D	2.30	2.81	3.38
K.S.	.000	.000	.000
Chi Square χ^2 (2 n =50) =11.964			
Asymp Significance .003			

Table 5.8: Blood lactate levels over three time points

A Friedman test was employed as the non-parametric alternative to a one way repeated analysis of variance. The result of the Friedman Test indicated that there was a statistically significant difference in blood lactate levels at the three time points as $p < .05$. Inspection of the mean ranks show a slight rise from Point A (1.71) to Point B (1.95), followed by a larger rise at Point C (2.34). Therefore following on from the flow chart a Wilcoxon paired wise test was conducted (Table 5.9)

Null Hypothesis	Significance level	Significance
Point A to Point B (on referral to on arrival)	$< .05$	.065
Point B to Point C (on arrival to Pre ECMO)	$< .05$	.008
Point A to Point C (on referral to pre ECMO)	$< .05$	.003

Table 5.9. Wilcoxon paired wise values for lactate levels over three time points

No significance difference was found between lactate levels on referral and levels on arrival of transport team .However there were significant differences between Point A and Point B, and Point B and Point C, and Point A to Point C , even with $\alpha .05/2 = .025$: Bonferri adjusted alpha value. Lactate levels had risen significantly between on referral and pre ECMO and from the time of arrival of the transport team to pre ECMO cannulation.

5.2.2.6. Mean Arterial Blood Pressure (MABP)

Table 5.10 shows the mean values and assessment of normality using the Kolmogorov-Smirnov test which showed violation of normality.

MABP (n = 50)	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	74	75.5	73.32
Median	75	75.0	74
Mean Ranks	2.09	2.03	1.90
S/D	10.77	13.94	16.02
K.S.	.095 *	.037	.200 *
Chi Square	$\chi^2 (2, n = 50) = 1.495$		
Aysmp Significance	.526		

Table 5.10: MABP over three time points

A Friedman test was employed as the non-parametric alternative to a one way repeated analysis of variance. The result indicated that there was no statistically significant difference in blood pressure across the three time points as $p = .526$) Inspection of the mean ranks show a slight decrease from Point A (2.09) to Point B (2.03), followed by another decrease (1.90) pre ECMO.

5.2.2.7. Adrenaline doses (micrograms/kilo/minute)

On referral there were only 6 patients on Adrenaline, but at the time of the arrival of the transport team this had risen to 12 patients, and by the time of cannulation onto ECMO there was still 12 patients receiving adrenaline infusions. The mean adrenaline infusion values are shown in the table 5.11, as is the distribution of normality using the Kolmogorov-Smirnov value, showing that two out of the three time frames demonstrate normal distribution.

Adrenaline levels	Point A (O/R) (n = 6)	Point B (O/A) (n = 12)	Point C (P/E) (n = 12)
MEAN	.291	.128	.129
MEDIAN	.250	.100	.100
S/D	.279	.078	.081
K.S.	.200 *	.097*	.025

Table 5.11. Adrenaline levels over three time points.

Inferential statistics with regard to Adrenaline levels had to take into account the differing numbers in the 3 different groups over time. On examination there were only 6 in the sample on referral, 12 on arrival and 12 pre ECMO. Of these numbers only 5 were present in all three groups and 10 present between time 2 and time 3. Using these numbers further statistical tests were then made. As only 2 out of the 3 time frames exhibited normal distribution the decision was taken to undergo non-parametric testing.

The first test: the Friedman looked at the 5 cases present in the sample population over the three 3 time points using a non-parametric alternative to the one way repeated analysis of variance (Table 5.12).

N = 6	Mean	S/D	Minimum	Maximum	Median	Mean Rank
On Referral	.274	.308	.020	.700	.120	2.20
On Arrival	.136	.089	.030	.260	.130	2.10
Pre ECMO	.132	.089	.030	.260	.110	1.70
Chi Square $\chi^2 (2, n = 5) = 1.077$						
Asymp Significance .584						

Table 5.12: Friedman test of adrenaline levels over three time points

The results of the Friedman test show that there is no statistical difference in Adrenaline levels across the 3 time points as $p > .005$. The mean ranks show a decrease overall the 3 time frames.

The second test used the Wilcoxon Signed Rank Test as a non parametric way of using repeated measures to further explore the 10 cases between time 2 and time 3. The results are as shown in table 5.13. The Wilcoxon Signed Rank Test shows that there is no statistically significant increase or decrease in adrenaline levels between point B and point C as $p > .005$, with a medium effect size ($r = .34$). The median scores show only a slight increase from on arrival ($Md = .100$) to pre ECMO ($Md = .105$).

N=10	Mean	S/D	Minimum	Maximum	Median
On Arrival	.129	.085	.030	.280	.100
Pre ECMO	.142	.083	.030	.280	.105
Asymp Significance (2 tailed) = .285					

Table 5.13: Wilcoxon signed rank test of adrenaline levels over three time points.

5.2.2.8. Noradrenaline doses (micrograms/kilo/minute)

There were the same 36 patients on Noradrenaline throughout the transport journey. A Friedman test was employed as the Kolmogorov-Smirnov test shows violation of normality. Table 5.14 shows the levels obtained.

N = 36	Point A (O/R)	Point B (O/A)	Point C (P/E)
Mean	.458	.460	.446
Median	.350	.335	.315
Mean Ranks	2.04	2.04	1.92
S/D	.520	.435	.451
K.S.	.000	.026	.009
Chi square	$\chi^2 (2, n = 36) = .470$		
Asymp Significance	.791		

Table 5.14. Noradrenaline levels over three time points.

The Friedman test demonstrated that there were no statistically significant increase or decreases in the levels of Noradrenaline between the 3 time points as $p > .005$. The mean rank scores in effect show a small decrease from Point B to Point C.

Over the three time frames, the mean values of the PH shows a worsening acidosis, together with a rise in mean PaCO_2 , and a decreasing $\text{PaO}_2/\text{FiO}_2$ ratio, together with a rise in lactate levels showed the patient was deteriorating with worsening ARDS and accompanied acidosis. The MABP however stayed the same despite a decrease in mean adrenaline, although more patients were receiving it, and a very slight increase only in Noradrenaline levels of infusion.

Neither the PH; PaO_2 ; PaCO_2 , MABP or the level of inotropes (Adrenaline and Noradrenaline), showed any statistical deterioration. There were two variables where the mean demonstrated a significant deterioration in patient condition: increase in lactate levels, and worsening $\text{PaO}_2/\text{FiO}_2$ ratio, between the referral of the patient, the arrival of the transport team and immediately prior to ECMO.

The literature review highlighted factors that can prevent or minimise deterioration or critical incidents including: transport logistics (Droogh et al, 2015), pre transport stabilisation measures such as following advice from the referring hospital (Ligtenberg et al, 2005, Borrows et al, 2010), interventions whilst at the referring hospital, and with the patient in situ (Borrows et al, 2010).

The data collected pertaining to these factors are shown in the next sections.

5.2.3. Transport logistics

The data collected concerning the distance travelled to the referring hospital, the duration, the mode of transport, and the type of retrieval are shown in the Table 5.15.

Parameter	Range	Mean	Standard Deviation
Transport Distance	2.1 – 310.5 miles	124.5 miles	7.4
Transport Times	10 -390 minutes	110	62.99
Mode of Transport	Road 42% Helicopter 8% Fixed Wing 8%		
Type of Retrieval	Conv 66% Mob 30% Conv/Mob 4%		

Table 5.15: Transport logistics

The average transport journey was 124.5 miles, taking 110 minutes. The most frequent mode of transport was by road ambulance with 42 (84%) patients transported this way, a further 4 (8%) by helicopter, and 4 (8%) by fixed wing.

Types of retrieval were categorised as: Conventional; Mobile; or Conventional – Mobile. In this study, 66% of the retrieval were conventional, 36% of the sample population required mobile ECMO retrieval, and 4%, were converted from conventional to a mobile ECMO retrieval.

5.2.4. Advice given to the referring hospital

Of the 50 hospitals that referred patients, 24 were given advice. Table 5.16 shows a summary of the advice given to the 24 referring hospitals (see Appendix 13 for details).

ADVICE GIVEN	PERCENTAGE (n = 24)
Respiratory Management	
Prone Patient	8.4%
Start HFOV	8.4%
Start Nitric Oxide	8.4%
Insertion of chest drain	8.4%
Insert novalung	4.2%
Repeat Chest x ray	4.2%
Actively cool	4.2%
TOTAL	58.0%
Fluid Management	
Give Frusemide	16.7%
Start CVVH	25%
TOTAL	41.7%
Cardiovascular Management	
Commence adrenaline	12.5%
Cardiac echo, or ultrasound scan	12.5%
TOTAL	25.0%
Give Blood	20.8%
TOTAL	20.8%
Other: CT Scan, review antibiotics, laboratory tests	20.8%
TOTAL	20.8%

Table 5.16. Advice to the referring hospital (n = 24)

In respiratory management prone positioning is often advocated to optimise lung function for patients with severe ARDS (Guerin et al, 2013). Installation of a novalung was recommended in two

instances due to time and distance to travel to the referring hospital. A novalung is an extracorporeal membrane device, which provides effective carbon dioxide removal but has little impact on oxygen levels (Hamid et al, 2011). It is sometimes advised as a rescue therapy prior to the establishment of ECMO. Fluid management advice was given to 45% of referring centres. Optimising the haemoglobin through blood transfusion was advised to 5 hospitals (20.8%), in order to increase the body's oxygen carrying capacity. Three hospitals (12.5%), were asked to start adrenaline, and three (12.5%), were asked to carry out cardiovascular checks through cardiac echo or ultrasound scan. Other advice included a computerised tomography (CT) scan; review of antibiotics; and testing for H1N1.

5.2.5. Interventions carried out by the transport nurses at the referring hospital

Retrospective data was obtained regarding the number and type of interventions carried out by the transport nurses at Point B: At Referring Hospital. Out of the 50 transport logs, 24 had documented a total of 38 interventions (Table 5.16).

INTERVENTION	NUMBER
Started Nitric	8 (33.3%)
Started Adrenaline	7 (29.1%)
Increased Noradrenaline infusion	5 (17.3%)
Given Frusemide	4 (16.6%)
Given Blood	4 (16.6%)
Given Bicarbonate	4 (16.6%)
Given fluid	2 (8.2%)
Insertion of chest drain	1 (4.2%)
Insertion of NG tube	1 (4.2%)
Given Magnesium	1 (4.2%)
Commenced on Amiodarone	1 (4.2%)
Commenced CPR	1 (4.2%)

Table 5.17. Number and types of interventions carried out by the transport nurses at the referring hospital

It can be seen that 33.3% were commenced on nitric oxide, an adrenaline infusion commenced in 7 patients (29.1%), with an increase also in noradrenaline infusion in 5 patients (17.4%). Giving frusemide to address fluid overload, optimising the haemoglobin, and correction of acidosis by giving bicarbonate, were the next highest interventions at 16.6% each. Fluid was also given to 2 patients. The number of interventions demonstrated that the transport nurses were active in maintaining and promoting patient stability. Table 5.18 shows the time the transport team spent at the referring hospital.

TYPE OF TRANSFER	MINIMUM TO MAXIMUM	MEAN
Conventional (n = 33)	39 – 130 minutes	77.6 minutes
Mobile (n = 17)	96 – 325 minutes	170 minutes

Table 5.18. Times spent by the transport team in the referring hospital.

The data shows that the average length of stay at the referring hospital for conventional ECMO was 77.6 minutes, whilst mobile ECMO was 170 minutes, the latter being longer due to having to take the patient to theatre.

5.2.6. Interventions carried out by the transport nurse during transport back to the base hospital

Table 5.19. shows the incidents and actions performed by the transport nurse during the journey back to the base hospital, the full details are shown in Appendix 14.

Cardiovascular interventions were the highest at 37.5%, spent in adjusting inotropic support. Medications at 29% showed interventions spent correcting acidosis by giving Sodium Bicarbonate. There were 7 occasions where blood was given, administration of colloid to 5 patients and 1 patient received crystalloid. Sedation was decreased in two patients and active cooling performed on 2 patients. FiO₂ requirements were decreased for 2 patients. Comparing the actions performed by the nurses with the length of time taken for the transport (Table 5.15), and referring to the narratives from the interviews, it appears that the longer the journey time the more interventions took place. However, this was on an individual patient basis. Transport nurses were active in trying to maintain and promote patient stability. As there was no control group used it is impossible to state whether patient deterioration would have occurred without their intervention.

INTERVENTION	NUMBER
FLUID RESUSCITATION	
Colloid	5
Blood	7
Crystalloid	1
TOTAL	13 (20%)
CARDIOVASCULAR	
Inotropes Increased	5
Inotropes Decreased	15
Commenced Inotropes	2
Cardiac Arrhythmias noted	2
TOTAL	24 (37.5%)
MEDICATIONS GIVEN	
Sodium Bicarbonate	12
Nitric Oxide commenced	2
Furosemide given	2
Glucose Infusion	1
Magnesium	1
Calcium	2
Potassium	1
TOTAL	21 (32.8%)
Sedation increased	2
TOTAL	2 (3.1%)
FiO2 decreased	2
TOTAL	2 (3.1%)
Cooling for hyperpyrexia	2
TOTAL	2 (3.1%)

Table 5.19. Interventions carried out by the transport nurse in transit with the patient.

5.2.7. Incidents occurring during transport.

Data obtained from the transport logs show the number of incidents or events that occurred during transport. These were not defined as 'adverse events' as they did not impact on the patient stability (Table 5.20).

INCIDENT	NUMBER	ACTION TAKEN
CVP line not working	3	Repositioned and re-sutured. Peripheral access used alternatively
Arterial line not working	1	New arterial line inserted in helicopter
Saturation probe not working	1	Arterial blood gas readings used.
Novalung fell out	1	Compression onto exit wound
Helicopter broke down	1	Landed safely and road ambulance retrieved patient

Table 5.20. Number and type of incidents during transport with the patient in situ

None of these incidents were classed as an adverse event as they did not impact on patient stability according to transport documentation.

Of the 50 patients in the sample population, 42 (84%) survived to discharge, and 8 (16%) died. Of those that died 6 were still on ECMO and 2 died after decannulation from ECMO. Length of stay at Glenfield ranged from two to 30 days (mean: 9.4 days).

5.2.8. Summary of the Quantitative Data Results.

The age range within the demographic data of a range from 18 years to 72 years was surprisingly given the upper age criteria for ECMO of 65 years (Annich et al, 2012). On examining the data there were two patients 70 years and older. On discussion with the senior ECMO team, this reflects the willingness of the base hospital to consider each patient individually taking into consideration their ability for rehabilitation and ventilation history. There were higher numbers of men to women than the national average, although the latter is probably a reflection of the small sample number. Weight deviated only slightly from the national average (ONS, 2011), with women being slightly over the national average and men being slightly under, again probably a reflection of the study sample size. Ethnicity did differ with a higher number of African descent but closer look at the data showed that 2 out of the 4 had a history of sickle cell crises which may have been a factor in their illness, although Barnes (2005), does state the case for a possible association between ALI and African ethnicity. The prevalence of pneumonia as a primary diagnosis lends itself to be an umbrella term for all pneumonias although some patients had a more defined diagnosis of legionella, community acquired aspiration and malaria pneumonia. The hours intubated at the time of referral was used to depict the length of stay in the referring ITU, as time of intubation was always documented whereas time and date of arrival to ITU was less clearly documented. Although there were outliers to this, the average was 53.69 hours, a mean of two and a half days. However, the wide range from 2 hours to 297 hours, could indicate either a reluctance to refer to ECMO unless absolutely necessary, or the applications of interventions over time by the referring hospital before referral. Unfortunately, as the study did not account for these factors it is impossible to state with any certainty the rationale for any delay in referral for consideration of ECMO.

The quantitative data collected yielded rich data in terms of the patient's physiological profile during the time period from referral of the patient to the initiation of ECMO. Few studies have supplied such details in a time series analysis. Ligtenberg et al (2005), considered 100 consecutive conventional transports, imposing a predefined threshold and noted variations around this measure. This study demonstrated that the patients were more critically ill than those in the Ligtenberg et al (2005), research. Bellingan et al, 2000, and Wiegersma et al, 2011, used parameters at time points in measuring the effects of a specialist retrieval team demonstrating another use of collecting data over time. A study of 40 patients requiring ECMO at the referring hospital utilising demographic details, severity of illness cores, physiological parameters and level of support was undertaken by

Forrest et al, 2011, a comprehensive study carried out by a number of researchers. All of these studies have been undertaken in professional research capacity. This quantitative study was constrained by a single researcher, but there was access to a lot of data. The common element with the previous studies and this, is that all have the potential to use the data collected for other purposes and further papers. The data also gave clarity to the degree of critical illness that the transport nurses would face. The mean values of the PH remained continually acidotic, with the means of PaO₂ and PaCO₂ both deranged, and mean lactate levels above normal. The ARDS ratio, already within the 'severe' category, did also show a significant decrease between referral and pre ECMO, by which time the ratio was at its lowest (more severe). The mean arterial blood pressure, although within normal limits, was supported in 42 patients by Noradrenaline with a mean over the three time frames of 0.42 mcgs/kg/min, and the number of patients receiving Adrenaline rose from six patients on referral to twelve patients on arrival and pre ECMO. Three hospital were asked to start adrenaline when advice was given at referral, but as noted, it is difficult to state whether this was a direct association. However, double the number of patients received adrenaline from the time of referral to the time of arrival. The transport nurses also documented started an adrenaline infusion on seven patients and increasing the dose of noradrenaline in five patients. In total, the transport nurses carried out 38 interventions at the referring hospital, not only responding to the patient's needs cardiovascularly, in inotrope management and fluid administration, but also proactive in reducing the PH through bicarbonate administration, offloading the patient through diuretics, and increasing oxygenation through initiating nitric and giving red blood cells. The transport nurses also carried out 64 interventions on the journey back to base with the patient. The highest percentage was in inotrope manipulation, and medications to maintain cardiovascular stability, twelve patients received Bicarbonate to reduce the lactate levels, and fluid resuscitation was also given. The interventions were not all proactive. Seven patients received blood transfusions to optimise them during the journey time ready for ECMO cannulation at the base hospital.

The quantitative data not only led to consideration and changing of the original research question but also provided the context within which the transport nurses work. It demonstrated the patient's vulnerability and their level of critical illness in the transport process through data obtained from their physiological variables, and in doing so highlights the risk/benefit needs that have to be considered in transport. Efforts to maintain stability and pre-empt deterioration was shown by the number of interventions carried out by the transport nurse both at the referring hospital and during the retrieval with the patient in situ. All of these were carried out within the constraints of time, time

spent at the referring hospital, and time spent on the journey home. These interventions were undertaken whilst also physically preparing the patient either for conventional retrieval, or for ECMO cannulation and then retrieval. Thoughts surrounding these constraints on time and the transport nurses' actions within these constraints led to the first initial thoughts surrounding the words 'actions' and 'time'. These were to be resurrected and their importance highlighted when they became inextricably linked with the grounded theory findings. Although the quantitative data yielded little in the way of statistically significant results, it played an important role in not only directing the focus on the qualitative results, but also laying a quantitative framework for the qualitative findings. The use of grounded theory to analyse qualitative data gave rise to an emerging substantive theory, and demonstrated the mental activities underlying some of the physical activities indicated in the quantitative data. It shows the transport nurses not only sustaining, but also optimising the patient in decreasing risks associated with transport. The next section presents the qualitative data results, the substantive theory of 'Acting in Time', outlining the stages undertaken to achieve the core category. Narratives are used throughout to demonstrate the process from initial codes, to the core category, and the incorporation of existing theories into the findings.

5.3. Phase 11 Qualitative results: The core category: Acting in Time.

The common aim of the transport nurses was to ensure that the right patient was in the right place at the right time. Their main concern was the safe retrieval of the critically ill patient to allow for appropriate care. They aimed to achieve this through mental and physical planning; preparation; effecting actions; and utilising skills and resources appropriately and efficiently. Transport nurses are the wheels round which transport activity revolves.

The core category '*Acting in Time*' emerged from two key categories: *Fostering*; and *Technological Moments*, and six sub categories: *anticipating needs*; *engagement*; *fit*; *mobilising*; *technological crossword*; and *belief in technology*. These key categories were then overlaid and subsumed into two pertinent extant theories of the Secure Base Model (Fostering) and the Actor-Network Theory (technological moments). This overall encapsulation of 'Acting in Time' is shown in Figure 5.1.

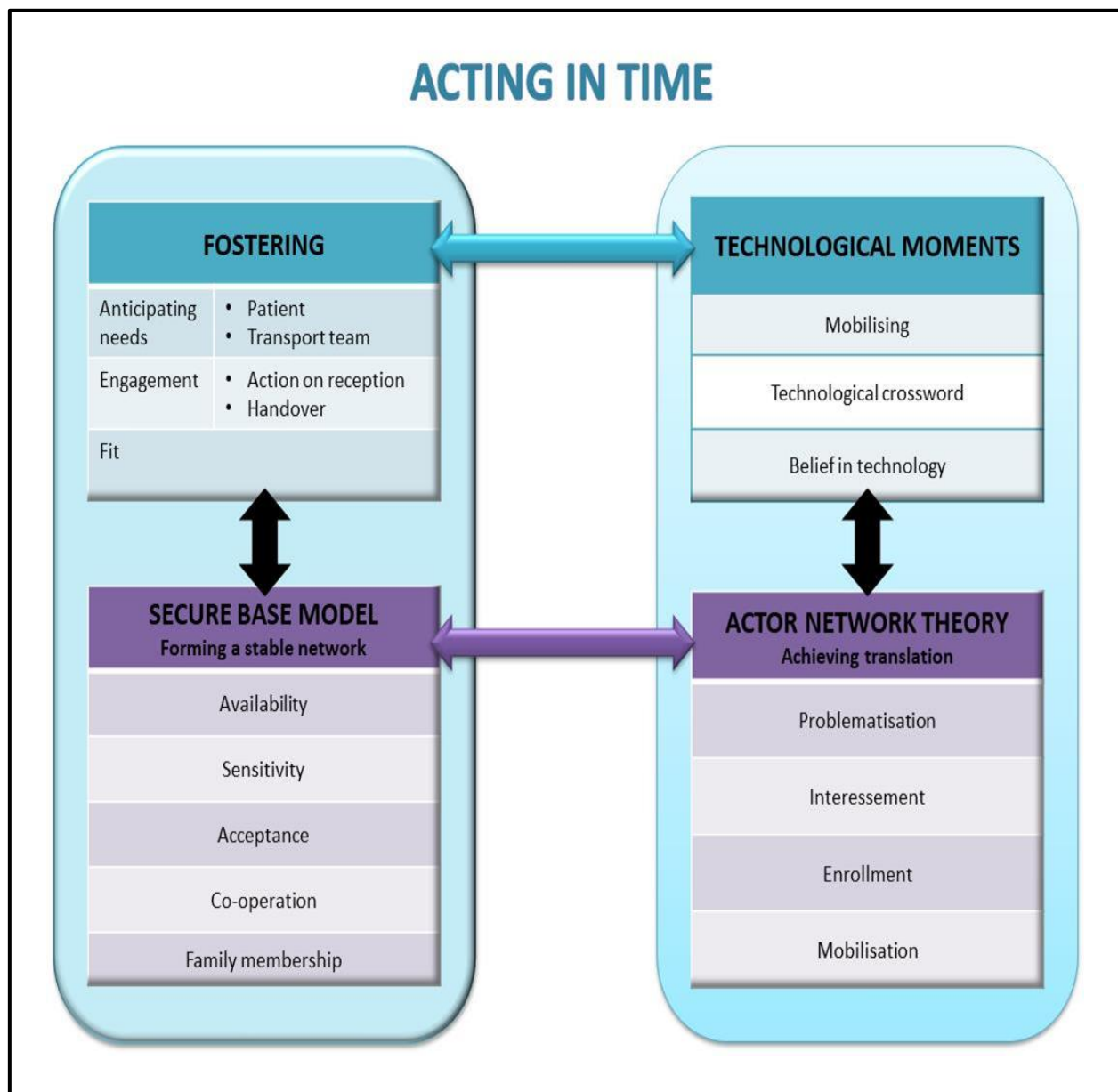


Figure 5.1. Summary of the research findings ‘Acting in Time’.

Transport involves a journey over a period of time. The main concern of the transport nurses was conceptualised as *Acting in Time*, which represented the ongoing process of a series of actions, both cognitive, and physical, with regard to: patient acuity; utilising and managing resources, both human and technological, and to ensure the optimal fit for the patient. The transport nurses had to respond to the patients’ needs whatever the circumstances and make appropriate judgements of

care. This was in a short and often limited space in time due to the seriousness of the clinical requirements of the patient. They frequently mentioned time regarding patient stability:

'...we all know an ITU patient's stability or measurements can change from 30 seconds to 30 seconds' (Penny (1): lines 220-221).

and the need to reach the referring hospital as soon as possible after referral:

'Your ideal thing is from time of referral to landing should be at the most 3 hours... because that can make such a difference in a patient's life really' (Linda (1): lines 39-41).

In the quantitative data, the time from referral to departure was not recorded due to incomplete documentation. However, constraints on time with regard to patient's stability impacted on the transport nurse in terms of anticipation; assessment; evaluation and response:

'...it's like a little computer in your head isn't it working everything out and adjusting how you are going to do things' (Linda (1): lines 69 – 70).

The concerns, worries, and strategies to initiate actions within time limits is expressed in almost mechanistic terms. Embracing and externalising the words of technology represents a synergy between thoughts and speech, according to Vogortsky (1978). Speech is the representation of inner thoughts and reflects thinking in pure meanings. Internalisation of knowledge and experience with technology leads to a translation which expresses a common meaning common that's understood in this technological age.

In this quotation Linda is expressing how she is going to adapt to patient instability through experience and knowledge, whilst acknowledging a familiarisation with technology. A belief in the power of technology drives the transport nurse to match the needs of the patient to the functions of technology, as a correct and appropriate fit for that patient. This matching of technology and patient requires this act to be as quick as possible, so that the transport nurse and technology can act together. Thus, both the acquired nursing knowledge, expertise and skills of an expert nurse, combine with utilising technology to potentiate action. Acting in time is the summary of the grounded theory, and the overlay of the extant theories as shown in Figure 5.1.

The next section outlines the development of the key category of *Fostering* through the subcategories of *Anticipating Needs*, *Engagement*, and *Fit*, followed by the application of the Secure Base Model (SBM) and its constituent values applied to the grounded theory findings of *Fostering*. This process is then repeated following the key category of *Technological Moments*, and the sub categories of: *Mobilising*, *Technological Crossword*, and *Belief in Technology*, the central beliefs of the Actor-Network Theory (ANT), and its application to *Technological Moments*.

5.3.1 Fostering

Fostering as a concept arose from the process of a transport journey being in synergy with a fostering process. Fostering is the short-term attachment to a person in need, to promote quality of life through nurturing; sustaining; advocating; and appropriate support. It is a journey of anticipating and preparing; extending the family by accepting responsibility; and ensuring the 'right fit' for all concerned. The outcome is to ensure that as far as possible those fostered are in the right place at the right time with the right people. Fostering in this study comprised of 3 sub categories: anticipating needs; engagement; and fit.

5.3.1.1. Anticipating Needs

Anticipating needs summarises the activities of the transport nurse with regard to patient and team needs. These needs differ and anticipating requires different actions in determining and meeting their needs.

- Anticipating the needs of the patient comprises: *initial profiling*; *filtering*; *acting on information*; and *changing profile*.
- Anticipating the needs of the transport team comprises *role clarity*; *role adaptation co-ordinating roles*; *conflict in roles*; and *nurturing*.

5.3.1.1.1. Anticipating the needs of the patient

Profiling is 'the practice of categorizing people and predicting their behaviour according to particular characteristics such as race or age' (OED, 2016). It is more commonly associated with forensic profiling, that is, extrapolating information on a person based on known tendencies or traits.

In nursing profiling is often used to explain the nurses' skill in making qualitative distinctions (Benner, Hooper- Kyriakidis, & Stannard, 1999), through familiarity with certain traits, expectations and trajectories of specific patient populations. In doing so they are anticipating the needs of the patient. The category of profiling the patient arose from initial coding properties of: initial profile creation, filtering; acting on information; and the changing profile.

The initial profile is created when the patient information is given to the transport nurse verbally by the ECMO Co-ordinator, and transcribed from the referral pro forma onto the transport log. Multiple parts of information are handed over at this time:

'you are given an overview, but you want obviously name, age, allergies, past medical history, ventilation, cardiovascular status, renal status, sepsis markers, access issues....family dynamics' (Anna (1):lines 5-8).

Faced with all this information the nurse starts to mentally assemble information:

'I kind of get a picture of what they are like before I get there' (Penny (1): line 4).

Memo's made following this quote were explored, noting that the internalisation of experiential clinical knowledge led to forming sets or expectations (Benner, 1984). The predisposition of groups of patients to act in certain ways is situational and contextual. Over time, this acquisition of theoretical and practical knowledge leads to clinical forethought (Benner, 1999), that allows the transport nurse to anticipate certain eventualities, and thus plan for action. Forming a picture is again the external representation of this process and reflects the inner speech or thoughts (Vorgotsky, 1978). Nurses rely on visual images and perceptual acuity, aided in ICU by external images such as monitors, to build up a picture of the patient. Picturing the patient prior to the actual realisation allows the picture to hold more clarity and subsequent nursing actions to be more targeted. This was also one of the strategies used by the transport nurses as a strategy to overcome their worries and concerns (Gustaffson, 2010).

After initial profiling, the nurses appeared to filter and refine information, channelling and seeking information and making it more pertinent to the patient. The strategy of filtering down to obtain

relevant and more specific information arose, through discussion with the ECMO Co-ordinator and/or the ECMO consultant:

'... then asking for the most relevant information you need about the patient, so for example if the gases have been steady, or if there is CO2 retention or there's hypoxia or whatever, and then obviously things like inotropes and how much they are on, I want to know if they got chest drains in or CVVH' (Anna (1): lines 4 – 8).

Moving from a general to a specific profile resulted in focusing action tailored to the patient, actions that would save time later:

"you want to know what drugs they are on, so if they are on lots of inotropes and things like that, making up an infusion and taking it with you' (Ellie (1): lines 4 – 5).

This engagement with preparation also extended to preplanning of activities in saving time:

'I want to know if they're on CVVH, because if they are about a half hour towards the end of the journey I will be ringing the referring centre and saying that if the patient is still on CVVH could you stop it so that it will coincide with our arrival' (Anna (1): lines 13-14).

Planning aims to speed up the process of moving the patient and reduce delays. However, despite planning, the transport nurses recognise the instability and changing nature of their patient's physiological status amid the patient profile they have built up, and so anticipate a change over time:

'... and I think patients change in the time you get on the ambulance to the time you get there, so even if the co-ordinator gives you a whole history, what you find when you get there can be very different' (Claire (1): lines 14 -16).

This nature of instability combined with experience, leads the transport nurse to expect a different profile from the profile they may have built:

'so what you are handed when you leave (the base hospital) can be very different from what you are presented with' (Penny: lines 222- 223).

In relation to fostering, foster carers also experience this idea of profiling, and recognise that information given may not match the actual reality (Nary & Owers, 2018). The quantitative data showed that in the study sample that there was no statistical difference in PH, PaO₂, PaCO₂, PAO₂/FiO₂, or lactate levels between referral and arrival of the transport team. The mean PaO₂/FiO₂ ratio of 94.86 at referral, and 98.2 on arrival of the transport team (Severe ARDS <100), does however indicate the severity of the critical illness in the sample population. Profiling the patient leads to an initial perception of the patient, further refined by seeking information and filtering down, which leads to preparatory planning and action. Nurses seek information to optimise the patient from what they know at that time. However, experience with critical instability and time constraints shows that the transport nurses are expecting changes to the patient profile.

5.3.1.1.2. Anticipating the needs of the transport team

McCallin (2001), defines teamwork as the way people worked together jointly and efficiently to achieve a common task, adding that team members who work together over time develop routinised tasks and expectations. In this study, there is little permanency as team composition can vary according to availability and type of transport. A transport team needs to be able to collaboratively work together in a non-fragmented way, and require knowledge of each other's roles, ways of working, and expectations, to be able to achieve safe retrieval of the patient. Anticipating the needs of the transport team requires the transport nurse to be proactive in: identification of the individual roles in accordance with the type of transport; responsive to different ways of working; co-ordinating roles when required; avoid replication of roles; and locate actions in space and time at each stage of the journey in order to promote a united front. The transport nurses acknowledge that it is their responsibility to achieve this task that is common to them in their daily working lives in ICU. Anticipating the needs of the transport team comprises the initial concepts of *role clarity*; *role adaption*; *co-ordination of roles*; *conflict in roles*; and *nurturing*.

Transport nurses noted that identification of the roles of the different team members enables clarity, demarcation and decreases the chance of overlap and ultimately saves time:

'...otherwise you end up with two people doing the same thing...and its daft if you are both doing exactly the same thing' (Ellie (1): lines 37 -40).

Ellie is saving time through economy of action by avoiding duplication of tasks. Identification of role is an important tool in this economy:

'I always have a chat to the doctor...and make sure they know which roles you are going to do, because like, if it's a conventional retrieval I like them to go off and have a quick look at the patient and then leave me to it, so we always go through our roles to see who is doing what' (Claire (1): lines 47- 50).

Establishing clarity in roles translates into action and impacts on the tasks undertaken. Mutual understanding of each other's roles enables the process of retrieval to be more co-ordinated and less fragmented. Preplanning ensures that the task is achieved as efficiently as possible. In the thematic study by Senften and Engström (2013), they found that careful planning, utilising the resources of team members, and teamwork by the transport nurses, optimised patient safety. Clarity of roles was perceived to be harder in mobile ECMO, as not only were there more members of the team, but the transport nurses needed further clarification:

*'...just before we get there it's a brief resume of what the team are going to do dependent on whether there's three or four of you, and it's like you go off and speak to the relatives and so I'm going to do etc etc.....but the other thing that I assert is like' ** (anaesthetist) when we've prepared the patient, do you want or are you prepared to scrub, or are you going to assist, or what are you going to do?'* (Anna (1): lines 17 -20, and 31 -32).

The ability to keep track of people over time is a skill acquired through multidisciplinary working in organising and conducting care to meet the needs of the patient. The transport nurse's role itself can vary according to the type of transport, and the different ways of working of the team members. Mobile ECMO requires the juggling of roles between transport nurse and theatre member, dependent on circumstances at the referring hospital. Role clarification identifies the task to be undertaken in the different roles. Transport nurses showed adaption both to variations in their role, and different ways of working. This adaptation to different roles Sellman (2011), argues relies on the professional virtues acquired by the nurse. This adaptability also occurs in fostering where the needs of the child dictate the roles of the foster carers ranging from providing nurturing through to dealing with multiple agency administration duties (Nary & Owers, 2017).

Transport nurses demonstrate a flexible approach to adopting different roles, through mentally preplanning and rehearsing different scenarios and dynamics in the situation:

'You are mentally thinking -is there going to be a scrub nurse? -if there's not a scrub nurse then you've got to re look at the dynamics of whose doing what' (Francis (1): lines 59 -60).

Training in theatre procedures equips the transport nurses with the skills, knowledge, and competency if required but it impacts on their transport role, so they learn to prioritise and delegate if necessary. Transport nurses prioritised the safety of the patient when considering adaptation to their role:

'...they've got the monitor in the room, they've got the ventilator ready, they've got the doctors and I'm thinking do I need to be here?, I'd utilise my services better if I was in theatre' (Anna (1): lines 102 -104).

Anticipating the needs of the team by familiarisation also occurs within the transport team, by adopting different approaches and actions within team dynamics. Overall, the transport nurse's perception of teamwork was being able to work as a cohesive unit, forming routines, making the process less fragmented:

'It's all about team work isn't it? because that's the other thing isn't it? if you are out with somebody and you know how they work it makes it so much easier because you can support that...I remember when I used to go out with X at the beginning and I didn't quite know how he operated being used to Y and I had to kind of establish his work, his work pattern, you know what he expected from me etc etc, and then I found I could work more methodically with him, and seamlessly, and now I feel that makes it smoother' (Anna (1): lines 111-118).

The transport nurses acknowledged this type of adaptation works well, but only over time and exposure to the same team members. They employed a different strategy if familiarisation with other team members had not been established. This focus on clarity, role adaption, and ability to prioritise, equipped the transport nurses with the skills necessary to co-ordinate roles if required. Knowledge of the skill set of each member, and the ability to locate them in time and space through preplanning,

enables smooth and effective co-ordination of roles to achieve the common aim of safe retrieval of the patient.

Co-ordination of roles occurred more frequently in mobile ECMO, where the increase in manpower led the transport nurses to direct and co-ordinate activities rather than simply performing activities:

'I think my role changes, it's more of a facilitating rather than a doing' (Claire (2): line 213).

Co-ordination entails managing and organising in a mobile ECMO situation. Constraints on time impels active management and co-ordination of personnel:

'I'd utilise my services better if I was in theatre telling people you know guiding people through the equipment, establishing who is the scrub nurse, who is the radiographer, all those kinds of things' (Anna (1): lines 102 – 106).

The mobile team have planned and practiced their roles beforehand, but the unfamiliarity of an ECMO retrieval for the staff at the referring hospital necessitates the transport nurse to take control, designating roles and tasks as appropriate. Sometimes this can be perceived as:

'...taking over as being bossy, you know having that complete control, but on the caveat side you've got to have control' (Francis (1): line 124).

Transferring responsibilities to other groups of staff was a strategy used to minimise worries and concerns of transport staff in the study by Gustaffson et al, 2010. Similarly Bryan & Ryan-Wenger (2009), found that being able to guide and manage self and others was one of the dimensions of knowledge and skills required within a deployed CCATT nurse.

The transport nurses anticipate the transport team's needs through: clarity; adaption; and co-ordination of roles, constantly preplanning, responding and acting to reduce delays, and optimising the retrieval of the patient. This did not always occur in a harmonious manner.

Transport nurses appear to assume responsibility for smooth team working from the initial stages until arrival at the base hospital. This imputes a physical and mental burden on the transport nurses, and reciprocation, or sharing of roles and tasks is not received wholeheartedly from other team members. This leads to internal conflict and frustration arising from an unequal division of labour. Transport nurses view a team approach as mixing and matching roles in order to achieve a timely approach to action:

'...work as a team, not fragmented, so at the start we all check the bags and equipment, instead of it just being the nurses, after all they need the equipment as well. I'm not saying we check it twice but divvy out the roles and responsibilities so it's a lot quicker' (Ellie (1): lines 82 -84).

Transport nurses promote teamwork through flexibly responding and adapting to the needs of the transport team. They do not demarcate roles but accept fluidity if necessary:

*'I think in a transport situation our roles are blurred and we have to muck in together. I mean there are certain doctors who are reluctant to help but now I just tell them what to do if they want to get out of the hospital and back to *****'. I can't be doing with 'that's not my job' attitude because otherwise it would take all day to pack and wrap wouldn't it?'* (Penny (1): lines 60 -64).

Demarcation impacts on time and division of labour. For the transport nurses responsibility inherent in transport came with a physical and responsibility divide:

' we (transport nurses) do all the physical stuff like moving lines, getting the patient onto the trolley, switching the pumps over, putting on our monitoring, running through the transducer, doing all the paperwork etc, and then the doctor just comes along and pops on the ventilator which I've checked and set up.. but it even occurs before then, often we're the ones doing all the preparation like checking the bags , getting the documents ready, getting the drugs ready, getting the trolley ready, and also mentally getting ready.....and some doctors expect us to lug all the stuff round when there is nothing wrong with their arms and legs' (Ellie (1): lines 65 – 77).

This division of labour occurs in both conventional as well as mobile ECMO:

'...you are on your own.....transferring the infusions over, packing and wrapping, putting all the cannulation stuff back, doing the documentation, disposal of drugs, packing up theatre sets, signing off documents, its everything, and that's where I think we need to balance those roles out' (Francis (1): 134 -137).

Balancing roles means balancing responsibility, sharing mental and physical tasks. Minimal team collaboration impacts on the efficiency and efficacy of the team and time. Working together promotes a positive attitude and approach:

'what makes a bad transport is the lack of team work.....I think the big thing for me is everyone working in harmony , which makes it good' (Penny (1): lines 125 – 126).

Dissatisfaction and conflict over task allocation and responsibility, however, did not deter the transport nurses from engaging in efforts to promote and enhance teamwork through nurturing. Transport nurses actively engaged in securing a future for transport through welcoming, engaging, and facilitating new members:

'whether or not we can get a trainee to come with us, you know like one of the transport nurses to get them involved, because they're the future aren't they, it's important to get the right person to go with you because some people even if you take them you know like - will just stand and talk and not do anything, you have to make sure they're engaging and proactive' (Linda (1): lines 28 – 32).

In nurturing trainees, the transport nurses noted limited opportunity due to physical space in the vehicle. Consideration of team composition was taken into account to maximise the learning opportunity, providing a positive learning experience in the right environment. This nurturing was also applied to the transport team itself. The length of the transport journey can vary (mean 77.6 minutes conventional, and 170 minutes for mobile ECMO), and staff can be exposed to periods without food or water. Most of the team, if feasible, make their own preparations but nurses help:

' The only other thing I add is sweets and drink' (Linda (1): line 49).

The transport nurses' enhanced teamwork by fostering and looking after team members, developing new trainees, and seeking to nurture team members through a common sharing of comfort and sustenance for all.

Role clarity, role adaption, co-ordinating roles, and nurturing, reflect the transport nurses' endeavours to optimise the patient by meeting the teams' needs, in order co-ordinate and deliver the right treatment to the patient as efficiently as possible. They also possess the ability to promote future team working through developing trainees and working to promote greater efficiency.

5.3.1.2. Engagement.

A retrieval necessitates engaging with the multidisciplinary team at the referring hospital for handover of the patient and to obtain help and support. Engagement shows the various levels at which this happens, and also describes the transition in responsibility for the patient. Fit encompasses the transport nurses' efforts to ensure that the right patient is in the right place at the right time Engagement comprises of three codes identified as part of the engaging process: *Action on reception*; *Handover*; and *Fit*.

5.3.1.2.1. Action on reception

The transport nurses generally agreed that referring hospitals were pleased at the arrival of the transport team:

'Yes they are pleased to see you, you're their help aren't you, this is the last ditch therapy - so they've been struggling with the patient for maybe days or hours and you are the shining light that going to make it all better..... so they say thank goodness you are here' (Francis (1): lines 67- 71).

This pleasure did not necessarily translate into actions towards engagement. Instead there was a spectrum of interaction ranging from: full, offering overwhelming help and support; to partial, wanting to be directed and led; through to none, offering no level of help at all. The first two approaches are narrated by Anna:

'I think that generally speaking I find referring centres to be very helpful, so you walk in and 'what do you want us to do, tell me what you want ' is a lot of them, and I think that a lot of them are occasionally you do get the 'big sigh' and they like to be led and you know sort of chivvy them along if it's not happening' (Anna (1): lines 80 – 84).

Claire describes the other end of the spectrum:

'other hospitals you arrive and they say 'thank god you're here' and you turn round and everyone's gone and you are on your own in a strange hospital with strange pumps and there's nobody to help you' (Claire (1): lines 177- 182).

The spectrum of level of help and interaction was noted by all of the transport nurses and started to raise questions which were further explored in memos and further interviews. The sense of relief indicated the burden of the patient on the referring ICU in terms of resources and manpower, but this did not translate in level of help and support necessarily. The variation in level of engagement by the nursing staff at the referring hospital occurred at the point of arrival of the transport team and appeared to be synonymous with the projected removal of the patient from the ICU. Further probing into this variation in embracement of the transport nurses yielded that the process was an informal transfer of ownership and of responsibility:

'I think that from the time you walk onto that unit the patient almost becomes yours , they are quite happy to just take their hands away and go 'there you go' (Penny (2): lines 56- 58).

5.3.1.2.2. Handover

The various levels of action on reception are associated with the handover of responsibility of the patient. Literature surrounding transfer of responsibility concerns itself only with the formal handover between medical staff as being the designated point of transfer of responsibility (Droogh et al, 2015). There are no guidelines as to the transition in responsibility between nursing staff as was apparent in the differences in reception.

The transport nurses identified that this handover of responsibility transitioned into four different ways: full handover of responsibility; partial handover of responsibility; delay in handing over

responsibility; and no handover. Full handover occurred when the staff at the referring hospital engaged fully with the transport nurses, giving a verbal handover, and giving help and support as fully as possible. Each of the transport nurses were able to describe this type of handover:

'...some hospitals are fantastic and you get there and it's like-what do you want, what do you need, what can we do for you and when do you want it?' (Claire (1): lines 177-179).

This type of engagement, handover, and support led to a smooth and timely retrieval.

'You've got staff there who are giving you a very good handover and introducing you to the family and so that makes it a very very quick and very easy to just you know pack up' (Ellie (1): lines 66 – 68).

Partial handover was noted in relation to drugs or procedures being delayed until the transport arrived. The responsibility for the activity was then handed over to the transport team. This caused frustration at the delay in treatment that had been advised at the referring centre:

'...you'll have suggested something like give Magnesium and they haven't actually given it but they've got it ready for you to give when you get there and you're thinking well this could have actually been running, or like say Bicarb or something like that' (Ellie (1): lines 103- 105).

Although not documented on the advice given to the referring hospital, the Medical Records Review noted that both Magnesium and Bicarbonate were given by the transport nurses at the referring hospital in the study. Reasons for this deferral were posited as unfamiliarity with the drug, or procedure, causing a lack of confidence or extension to scope of practice. Differences in practice does exist within and between ICUs:

'I've always wondered whether it's just a case of they are either not used to giving them (Drugs) and don't feel confident to give them, or it's a case of it's not their normal practice and they don't really agree to giving them, so it's up to us to give it when we arrive' (Ellie (1): lines 109 – 111).

Delay in handover and responsibility occurred in a mobile ECMO retrieval but was viewed positively by the transport nurses. After initial assessment by the transport nurse, decisions were made as to

the capability of the ICU staff in safely transferring the patient to theatre. If they were reassured, the transport nurses then deemed that their skills and time were better utilised by progressing to theatre, thus delaying taking ownership of the patient until the point in time when the patient arrived in theatre:

'If there is a lot of staff around and they appear to be in control then I often say 'I think what we will do is go round to theatre and prep the theatre team'.....because let's face it they know the patient and we don't' (Annie (2): 95 – 98).

There is a conscious decision to leave the responsibility of the patient to the current team who have experience with the patient, until the patient enters the theatre environment:

'I leave the transport of the patient from ITU to theatres to them, because at that point in time it is still their responsibility' (Claire (2): line 210).

Once inside the theatre the transport nurses take responsibility. Knowledge and experience with previous ECMO cannulations lead the transport nurses to facilitate this confidently, and at this point that they begin to assume the roles and responsibilities required. Once cannulation is finished the transport nurses implement the final stage of handover, the packing and wrapping of the patient. Engagement with staff in this context is easier to manage as people are keen to see, and learn, from the mobile ECMO cannulation experience:

'The ITU nurse usually likes to come and have a look, and then you've got a couple of anaesthetists that are around and like to have a lookthere are a lot more people milling around and I tend to make the most of that as soon as they are cannulated' (Claire (2): lines 222 -224).

Delay in handover in these scenarios benefited the transport nurses as it allowed them to utilise their skills and actions in ensuring the cannulations was more efficient. They were also able to engage with staff watching the procedure. This contrasted with the actions resulting from no handover or transition of responsibility. The latter actions left the transport nurses feeling exposed and vulnerable. All the transport nurses described at least one scenario in which this happened:

'...not helpful to the point where they will actually go off and leave you with the patient , you haven't had a proper handover and the staff go 'yeh I'll just go and make up your stuff' and then they just disappear' (Ellie (1): lines 69 – 71).

Lack of engagement and stepping back from the patient mentally and physically was noted to the transport nurses dismay:

*'I've had that happen where the staff like they go ' yeh I'll go and make up your stuff' and then they just disappeared, so I was stuck in a side room on my own with a patient I hadn't had a handover on, I didn't know how to work the monitor, I didn't know how to work the pumps and it was a bit of a 'like 'whoah' if something goes wrong now I'm going to look like a **** cos I'm going to have to shout for help, and I would you know' (Ellie (2): lines 72 – 77).*

Brewer & Ryan-Wenger (2009), identified that one of the domains for knowledge and skills required to look after critically ill patients was that of clinical competence, which included the ability to work alone if necessary. Whilst that might be expected of CCATT nurses it is to be noted that they do perform their role within a tightly structured and organised team. The experience of the NHS nurses within the study environment was contextually different. The transport nurses described feeling abandoned, exposed to unfamiliar equipment and practices:

'We got to the hospital and it was their last patient on the unit and there were eight beds, so 7 were empty, and all the staff disappeared - I was left (the doctor had gone to speak to the family_ literally ON MY OWN - there was literally no one else left on the unit, slightly unsafe and slightly unnerving, and I had to go and leave the patient on their own and go and find somebody to help me' (Francis (1): lines 190 – 196)

Faced with this, the transport nurses advocated one of two strategies: shout for help; or risk assess the situation, the former temporarily increasing the patient's vulnerability in order to physically obtain help. Further probing and transcribing led to various thoughts concerning this behaviour. The transport nurses were generally very accepting of this behaviour, as well as accepting the patient.

Acceptance means accepting both strengths and weaknesses. The transport nurses in accepting weaknesses became non-judgemental in their views on rationale for behaviour, except when the

safety of the patient may be compromised. They empathised that an ICU nurse is constrained by time and bureaucracy:

'they are just very very quick to want to just do their paperwork, I've had a couple where they just sat leaving me to get on with everything because they were busy with their paperwork' (Ellie (1): lines (102 -104).

Although frustrated at the lack of engagement the transport nurses tried to perceive the retrieval from the referring hospital's point of view. Using these skills, the transport nurses found two reasons for lack of engagement: no prior exposure or experience with an ECMO transport, and the acuity of the patient. ECMO transport is unusual for most ICUs and therefore experience in preparation for retrieval and possible ECMO cannulation may not have been obtained:

'...to be fair to them they have no idea of what to expect unless it has happened before' (Francis (1): line 52).

This included dealing with unfamiliar drugs as mentioned previously, and not knowing what to expect of the transport team. The transport nurses recognised the pressure and workload that comes with maintaining a stable critically ill patient:

'On the whole I think they are very good, the referring centres, because the amount of pressure they are under, trying to save someone's life, and they are the sickest patients they are ever going to get' (Linda (1): Lines 90 -92).

Recognition of pressure and acceptance transformed in non-judgemental action when confronted with the patient. They projected professional comportment, holding back natural reactions and comments:

'We don't make any comments like 'oh my god, what have you done with this patient?' we just act professional and try to be as sleek as possible and enlist their help if we can' (Ellie (1): lines 120 – 121).

Whilst recognising acuity, the transport nurse laments the apparent lack of comfort care for the patient. They maintained a non-judgemental stance and demeanour, thereby not erecting barriers, although mentally determined to action care as soon as possible:

*'I mean it's when you get there and you go 'when was the last time they were rolled?' and they say 'well I'm sorry the patient is in a pile of *** ,I haven't washed their mouth for three days because we haven't been able to move them, and you get there and I think 'It doesn't matter how sick your patient is you can still get a pink sponge in their mouth".. and I know I'm going to scrub that patient as soon as I get back' (Claire (1): lines 123 – 128).*

When clinical practice was going to breach patient safety then non acceptance was employed by the transport nurses. They gave examples of cutting corners in health and safety, and questioned policies and practices that were governed by national guidelines. Ellie relates asking one referring hospital to relocate a central line to facilitate an ECMO cannulation. On arrival at the referring hospital the line had been moved, but the transfusions were all still running on the original line. She asked them to start using the new line, which they did, transferring the infusions lines across. NICE guidelines (2017), state that administration sets should be changed at each intravenous cannula change, which Ellie was aware of:

'In that case with the central line they didn't want to make up new infusions so they were going to put all the old infusions on the new central line, and I sort of questioned it and said 'well wouldn't you put fresh infusions on that line' and they were like 'oh well they haven't been running for very long' and it was almost going to turn into a battle of wills because they had no intention of making up new infusions , but obviously that wouldn't be our practice normally, putting old infusions on new lines' (Ellie (1): lines 182-188).

Ellie therefore questioned the practice but explained further that the acuity of the patient precluded further conflict and received the infusions through the original lines. Ultimately the transport nurses concluded that the long-term repercussions of bad practice lay with handing over of responsibility:

'...because they know you're taking the patient out of there they are not really too concerned about what goes on in that part of the care because it's not going to be their problem anymore,...you know

the incident form isn't going to come to them or so you know they become a bit too lax' (Ellie (2): 95-99).

Transport nurses approached the referring hospital with intent to engage through a calm and friendly demeanour, empathising with their pressures on time and patient acuity.

'I go in there as if we were guests on the unit and we have to respect them' (Linda (1): line 76).

They wanted to present a cohesive team approach, working smoothly, competently, upholding good practice, looking proficient, and expert in their practice:

'I hope it looks really slick and together and you know the clinical experts coming in be professional' (Francis (1): lines 156-157).

This outlook corresponds to a mental and emotional attitude of confidence and success which was also one of the domains required for a CCATT transport nurse (Brewer & Ryan-Wenger, 2009). Above all that transport nurses in this study were united in wanting to leave a good impression as an impetus and drive to optimise and maintain future critically ill patients:

'I don't want to walk in and make them feel they've not done a good job because obviously they may need to re refer to us, so I'm always very aware of how I present myself' (Claire (1): lines 55 – 57).

Overall, the actions of the transport nurses in these situations considered time and the patient to be their priority. The time spent at the referring hospital ranged from 39 minutes to 130 minutes for conventional, and 96 minutes to 325 minutes for mobile ECMO, the latter taking longer as a trip to theatre was necessitated. The differences in time for conventional could be related to the level of preparedness and level of engagement by staff at the referring hospital requiring the transport nurse to sometimes undertake a more autonomous and time-consuming role. It could also reflect the lack of resources at the referring hospital. For 8 out of 50 patients (33.3%), Nitric Oxide was commenced using the Nitric available on the conventional retrieval trolley and Adrenaline was started in 7 out of 50 patients (29.1%). More patients were referred on Noradrenaline infusions than Adrenaline (36

patients compared to 6 patients), as this is in line with the advice given in the sepsis guidelines (Dellinger et al, 2008).

5.3.1.3. Fit

Fitting the profile is relating the anticipated patient acuity (profiling), with the reality on arrival of the transport team. Ensuring the right patient receives the correct treatment in the appropriate environment is the core of determining fit. Optimising fit refers to the transport nurses' actions to anticipate and prevent deterioration in. Codes contributing to 'fit' were: *fitting the profile; determining fit; and optimal fit*.

Not fitting the profile was not solely attributed to the physiological deterioration of the patient, but also related to information withheld by the referring hospital, intentional or not. Comments by the transport nurses about information obtained by the referring hospital indicate an expectation that thrift was employed:

'I mean they are never as sold are they? there's always some little gem the hospital forgot to mention... and you think -what? really?' (Penny (1); Line 32).

Anna gives an example where a patient had gangrene of the legs and this was not mentioned at referral and the patient died during transport. Other examples were: length of intubation, and undisclosed co-morbidities. Lack of appropriate information and communication between inter hospital transfers is not isolated to this study. Usher et al (2018), note that one barrier to a patient receiving co-ordinated high value care is that of incongruent information systems and indirect and uncoordinated communication. Similarly, Mueller and colleagues (2020), noted challenges in their study to communication part of which arose within inadequate exchange of clinical information for both referring and receiving hospitals. These types of errors led to the potential of the patient being accepted for ECMO, when they didn't meet the criteria. This leads to an unnecessary retrieval, negatively impacting on actions and time. Lack of, or omissions in communication between the referring hospital and the ECMO co-ordinator accounted for some of the discrepancies in patient status:

'You go out and pick up a patient and that's not the one that was sold to you, that's a difficult one because you are coming back with someone who for example has been on more inotropes than you were led to believe, or the inotropes were hiked up when you were on your way and nobody seemed to mention it, or the patient had a cardiac arrest on your way there' (Anna (1): lines 128 – 132).

Misinformation and a breakdown in communication with regard to patient co-comorbidities, and lack of awareness of acuity in 'real time', led to frustration, as it impacted on the decision making process about the best option and placement for the patient – thus determining fit. Following the initial assessment and determination of actual instead of perceived acuity, the transport team then make decisions as to whether or when the patient receives ECMO, the location of cannulation, or to bring the patient back to the base hospital for advanced respiratory care. In this study 2 out of 50 patients (4%), were worse than originally thought. The conventional team were sent out due to the referral information. On arrival the patients had deteriorated to the extent that a conventional retrieval was deemed too risky. The mobile team were then assembled and dispatched and the patient put onto ECMO at the referring hospital.

Regarding the decision-making process the transport nurses were comfortable in the application of ECMO criteria and confident in the outcome. What they found uncomfortable was the grey areas where the patient didn't fit the criteria, but they expressed doubt that the referring hospital could maintain patient stability:

'you get there and you look at the patient and you think they probably don't need ECMO but if we leave them here, give them 24 hours and they will, and I won't leave this patient here' (Claire (1): lines 167 – 168).

Claire fears that over time the patient will deteriorate and remarks that it is her 'duty of care', (1; line 172) to bring the patient back to the base hospital. Other transport nurses noted that once they had accepted responsibility for the patient, they became the patient advocate. They expressed confidence in their base environment to offer something that the referring hospital wasn't able to, even in the face of adversity:

'They are obviously out of their depth, the patient is going to die unless we bring them back, okay they may die with us but at least we have the resources to try and prevent that' (Penny (1): lines 71-74).

Patient advocacy and duty of care was the priority of the transport nurses in these grey areas as the risk of transporting the patient was thought to be more beneficial than leaving the patient. Decreasing the risk of critical incidents during transport includes the risk of leaving the patient at the referring hospital. It demonstrates a belief in staff, equipment, and technology at the base hospital. The transport nurses spoke of the conflict though in these grey area scenarios. Responsibility, patient advocacy, and a desire to put the patient first whilst making the correct decision, brings conflict, better faced with familiarity than a sense of alienation:

'...we have been out and taken a look at the patient and things are obviously different and we can't take the patient, and again that's a very tough call to make, and sometimes you bring patients back that you wouldn't necessarily have done if they were in your hospital, because when you are in a referring hospital you are out on a limb. It's a very difficult decision and call to make even if you've got the back up of your referring hospital and your base hospital, you can call for advice but it still is a very lonely place to be' (Claire(1): lines 270 – 276).

Feelings of isolation and vulnerability demonstrate that the support and aid in making decisions and taking actions is easier in a permanent ICU than it is in a mobile situation.

Optimising the patient is synonymous with optimal fit and the transport nurses demonstrated through their actions that they were proactive in attaining this. The quantitative data in this study supported the actions of the transport nurse, particularly in relation to lactate levels and a deteriorating ARDS picture. The transport nurses were aware that retrieval itself increases the patient's vulnerability. They aim to optimise the patient whilst in the referring hospital using available resources.

'I say can I have enough propofol for the journey back, can I have enough adrenaline to get the patient back....so you now if you're 4 hours away then you have enough inotropes, enough sedation, to get them 4 hours' home, and a bit more besides, because you know ambulances break down, you get stuck in traffic, things happen en route' (Claire (1): lines 102 – 10

Consideration of time, and drug usage, to prevent risk is shown as well as optimising care through adequate sedation. Correcting current problems, and anticipating future needs of the patient to sustain optimal fit, were the actions carried out by the transport nurse on the journey back to base:

'I usually give Bicarbonate to correct acidosis, blood and am titrating inotropes' (Claire (1): line 277).

Detection of changes in acuity occurred through monitoring and documentation, enabled the transport nurses to respond quickly:

'...it's a case of more monitoring, doing the observations and then may be having to titrate inotropes, maybe having to give some fluid' (Ellie (1): lines 130 – 131).

Additional information that informs the actions of the transport nurse is obtained from blood samples, and corrections can be made in real time. The narratives concur with the quantitative data in Table 5.19, where 22 patients (34%) had inotropes altered, 12 patients (18.7%) had bicarbonate given, and 13 patients (20.3%), received fluid resuscitation

Optimising fit during this period of time consists of rapid response through vigilance, utilising resources available at this point in time. Coupled with this vigilance and actions, experience and experiential knowledge possessed by the transport nurses, allows them to be prepared for the unexpected. This is critical in optimising fit and decreasing risk:

'something can happen on the way back, that's unforeseen, and experienced nurses can see it coming, you know you can pick up on things and you can almost anticipate you know for some reason if they've got a low calcium maybe they will arrest in a minute...' (Anna (1): lines 154 – 156).

Benner (1999), would identify this as 'intuition', the transport nurses ascribe this to their ability to anticipate and predict patient acuity. They compute previous and current information to formulate instantaneous action, thus acting in time:

'it's like a little computer in your head isn't it working everything out and adjusting how you are going to do things' (Linda (1): lines 69 – 70).

Fitting the profile, determining fit, and optimal fit described the thoughts and actions taken by the transport nurses to match a patient to the correct treatment in the right environment and at the right time. The overall care, attention, thought and action are similar to the process I thought of originally as 'adoption', adopting the patient and paying attention to detail to ensure the patient was assessed, maintained, optimised, and stabilised for the initiation of ECMO if required. However, the concept of adoption implies permanency and the patient if able, will require transfer back to the referring hospital. So, the idea of fostering, a temporary caretaking to allow nurturing, appropriate intervention at timely intervals, a short-term temporary management of care in order to enhance lives, was the term used instead. With this in mind the concept of fostering was explored leaning heavily on social work practice, policies, and research.

5.3.2. Fostering in Context

Fostering encompasses many forms: emergency; short term; short breaks; remand; fostering for adoption; family and friends; specialist therapeutic; and long term. However, the principle remains the same, people (foster carers), taking and looking after children in their own homes, on a temporary or permanent basis. As on the 31st March 2017, there were 53,420 children in foster care, and increasingly those entering foster care have encountered serious problems (Nary & Owers, 2018). These children therefore are growing up without their own family and therefore this places responsibility on the foster carer, to provide stability, build trusted relationships, instil and build confidence, meet their emotional needs, build resilience, enhance talents and provide a base from which to develop and enter the adult world (Beek and Schofield, 2004, Nary and Owers, 2018). Parallels exist between foster caring and nursing. Overwhelmingly foster carers view their role as a vocation, with caring, commitment, experience, resilience, and persistence being the crucial qualities. Foster carers need to possess and develop skills to fulfil the requirements and undergo continuing development. Nurses also commit to lifelong learning as they progress from novice to expert along their chosen specialty (Benner, 1984). Fostering is carefully regulated and adheres to a range of policies and procedures. Nurses have to adhere to their code of conduct (NMC, 2018), and policies and procedures to ensure safe and evidence-based practice. Both groups undertake administrative roles and documentary tasks in order to fulfil their role and responsibility. Fosters carers are the key part of a team, working closely together with outside agencies to perform to their best ability when looking after children and young people (Nary & Owers, 2018). Similarly, nurses work with multidisciplinary teams to ensure the best outcome for their patient. Both foster carers and

nurses also act as advocates in promoting the best interest and care for those concerned (Figure 5.2).

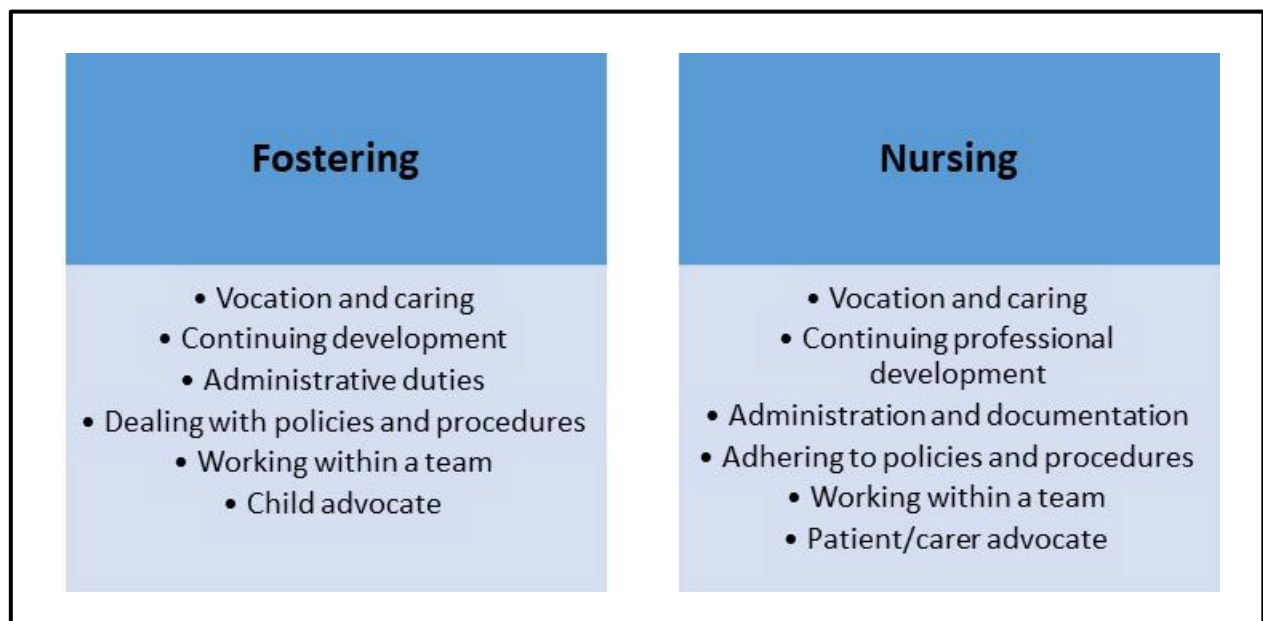


Figure 5.2. Similarities between fostering and nursing.

More specifically similarities exist between the role of the foster carer in emergency and short-term care, and the roles of the transport nurse. Both require being available or on call 24-hour hours a day, in order to meet the required needs (Nary and Owers, 2018). Organisation of resources need to be operationalised in order to plan and prepare to meet requirements. The needs of foster children have increased in terms of the exposure of the foster child vulnerability and prior experience of abuse or neglect. Similarly, patient acuity has increased due to demographic and technological ability to sustain/maintain sicker patients. Matching the needs of the child and the skills of the foster carer is increasingly challenging due to geographical variance, and an increase in skills and knowledge from the foster carer. This may lead to a provisional mismatch whilst a more appropriate placement becomes available. Matching of placements also occurs in healthcare as hospitals seek to place patients in a more appropriate setting due to specialisation and regionalisation. These similarities are summarised in Figure 5.3.

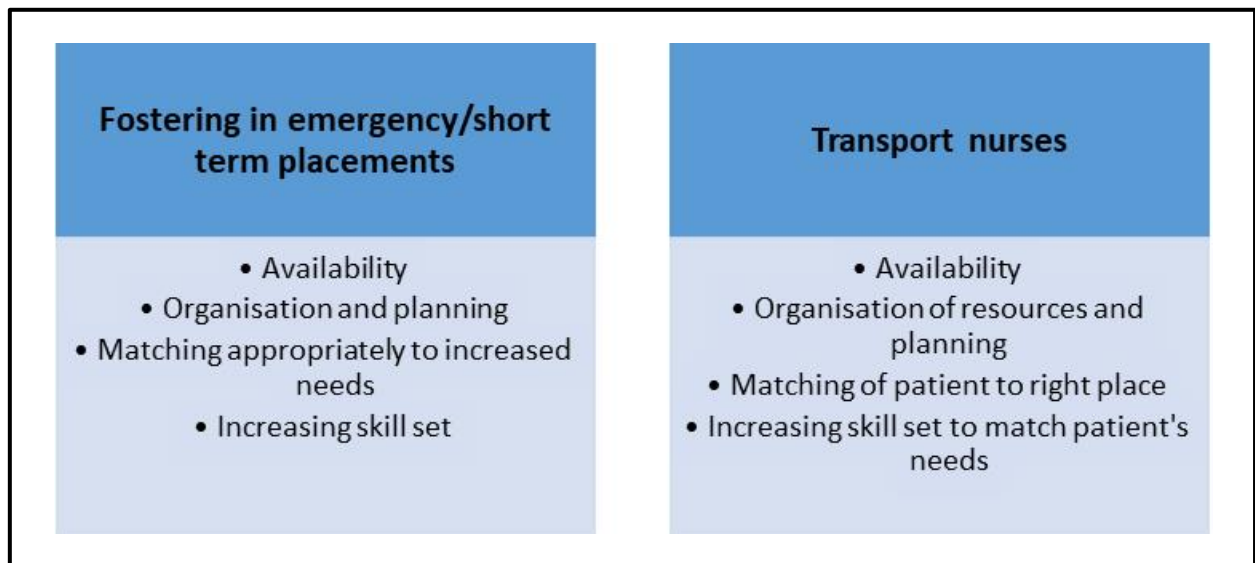


Figure 5.3. Similarities between foster carers and transport nurses

Demands on both the foster carer and the transport nurse of: availability; planning and preparation; appropriate placement; and matching skills to needs, have to be met. For the foster carer this demand resulted in an increase in the focus on the role, training and the boundaries of the foster carer, and one outcome of this was the Secure Base Model (Beek and Schofield, 2004), the framework for which provide explanations for the qualities and actions of the transport nurse.

5.3.2.1. The Secure Base Model

The Secure Base Model (SBM) (Beek & Schofield, 2004), outlined in Chapter 2, aims to provide a secure base through the physical, mental and emotional availability of the caregiver. This is achieved through five overlapping dimensions of caregiving: availability; sensitivity; acceptance; co-operation, and family membership. To recap, this is shown in Figure 5.4

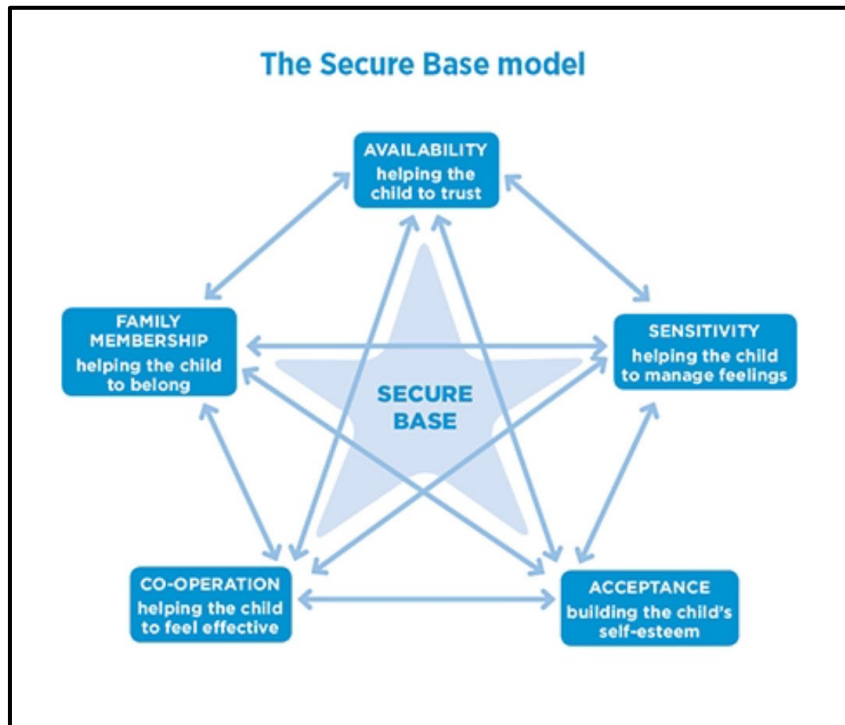


Figure 5.4. The Secure Base Model (Providing a Secure Base, Gillian Schofield and Mary Beek, University of East Anglia, Norwich, UK.)

The Secure Base Model and its focus on the five dimensions makes clear the qualities required to be an efficient and effective caregiver in providing a secure base. This model is now applied to incorporate and explain the qualities described in the transport nurses' narratives.

5.3.2.1.1. The Secure Base Model and its application to transport.

5.3.2.1.1.1. Availability.

Availability encompasses three areas of skills and qualities; emotional and physical availability; time to anticipate and prepare; and the capacity to reflect and respond in a flexible way to adapt to differing needs (Beek and Schofield, 2004). For transport nurses there is an expectation that transport teams will also be ready in place to respond to the patient's need appropriately with correct skills and resources available. The willingness to be available emotionally and physically stems from an intrinsic belief in ECMO and a desire to gain stability, through 'saving' or rescuing'.

This belief overrides complacency and drives the desire to action:

'we can't leave them there can we' (Penny (1): line 37).

The wish to place the right patient in the right care through physical action and motivation is defined as moral agency (Peter, 2002), and is the drive to prioritise needs, be creative and flexible in action, enacted through relationships with the patient (Peter, 2002). In transport, the nurse is unable to engage in a relationship with the patient due to their critical illness, instead the transport nurse directs attention to engaging in communication with staff at the referring hospital in order to gain information to react to the patient's needs. Socially constructed, moral agency is the foundation of nursing practice (Peter, 2002). Emotional availability is intrinsic, whilst physical availability entails planning and preparation, such as checking of equipment and resources, and possession of the relevant skills. Personal and physical readiness is also found to be one of domains of knowledge and skills required for CCATT nurses (Brewer & Ryan-Wenger, 2009). Anticipation and preparation is affected by time constraints for the transport nurse, as they optimise or economise time both physically and mentally:

'I do as much of the paperwork en route as I can, anything that I do en route will save me time when I get there' (Anna (1): lines 11-12).

"so while I'm in the back of the ambulance I have a quick look at the bag and sort of try and memorise and note..... just so that I can get to them quickly' (Ellie (1): lines 34 – 36).

Anticipation and preparation links thinking and action where cognition informs action, derived from experiential learning and development of previous sets and expectations (Benner et al, 1999). The action of profiling demonstrates thinking in action, filtering to patient specificity refined the sets, and informed choice of correct equipment and preparation.

'I always make sure that the trolley is set up for the right patient' (Ellie (1): line 23).

Adaptation and response to differing needs of the patient was expressed in the concept of profiling and described in: fitting the profile; determining fit; and optimising fit:

'... and I think patients change in the time you get on the ambulance to the time you get there, so even if the coordinator gives you a whole history, what you find when you get there can be very different ' (Claire (1): lines 14 -16).

Availability, time to plan and prepare, and responding appropriately to differing needs are dimensions needed to achieve the aim of stability and to reach a secure base. Lack of any of these three components can lead to vulnerability. The transport team need to be available and possess the appropriate skills to retrieve a patient in a stable yet timely manner. Planning and preparation, profiling, and checking ensures confidence in correct and safe equipment being utilised. Dealing with differing needs over time allows for adjustment to patient acuity and decisions undertaken that have the patient's best interests at heart.

5.3.2.1.1.2. Sensitivity

Sensitivity requires the ability to view the world from other people eyes in order to sensitively perceive their range of thoughts, feelings and rationale for behaviour. An expert nurse has the ability to view health and illness from the perspective of the patient and relevant carer. They acquire skills to cope with emotions and actively reflect upon their behaviour, and that of others. In transport due to patient acuity, what is required is the ability to view through the lens of all the staff involved, to reflect on. To sensitively perceive rationale for different types of behaviour enables the transport nurse to deal appropriately and respond sensitively. The transport nurses were able to appreciate the burden of patient acuity on the nursing staff at the referring hospital, and the demands made upon them

' I think sometimes may be we do put a bit on them, more of a demand 'can you get some blood available, can we have photocopies, ...plus maybe we want them to change the central line..now the Consultant wants it in the groin, and then we're asking them to make up enough infusions to get us back' (Anna (1): lines 62 – 66).

Although they showed frustration at the apparent lack of preparation at the referring hospital, they were also able to perceive and rationalise for this behaviour:

'If nurses haven't had the experience or exposure to those types of patients or are not used to looking after patients that sick' (Claire (1): lines 155 – 156).

This led to rationalisation regarding information or advice given at referral:

'now maybe because sometimes the nurses aren't involved in that conversation, maybe it's because the medical team get called away you know, other responsibilities' (Francis (1): lines 63 – 65).

And they suggest that this communication should be relayed directly to the nurse looking after the patient:

'I think when you take a referral you are not really speaking to the right person; I think speaking to the nurse who is looking after the patient is paramount' Linda (1): lines 109 – 111.

Sensitivity led the transport nurses to rationalise that advice and preparation of the patient was demanding and communication could be better directed. This influenced their behaviour in trying to be welcoming; employing a non-judgmental approach; acknowledging differences in nursing practice, and minimising conflict through understanding:

'I always go in there as if we were guests on their unit and we have to respect them' (Linda (1): lines 76-77).

Awareness of lack of expertise and demands of the patient allowed a non-judgmental approach to be adopted by the transport nurses'

'I don't want to walk in and feel like I'm stealing their patient or making them feel they've not done a good job I so I'm always very aware of how I present myself to them' (Claire (1): lines 52 – 53).

In giving rationale for behaviour the transport nurses were also able to explore lack of engagement or support in relation to scope of professional practice:

'obviously be professional but tread carefully, it's an unfamiliar environment and not in their scope of practice. , maybe they have been put into a position they are not comfortable with, and you can see it and understand that because you are asking them to do things' (Francis (2): lines 56 – 58).

The transport nurses demonstrated understanding of these issues by compromise, negotiation, or performing the task themselves. They were sensitive to others and demonstrated awareness of the skills and practices of their colleagues through anticipation and establishment of roles. This skill enabled the transport nurses to respond appropriately to differences in behaviour of the referring staff. They were able to perceive barriers to lack of preparation and communication, appreciation of policies and procedures, and gave intent to create a positive perception of the transport team.

Sensitivity or lack of, can also lead to vulnerability for the patient and the transport nurses by non-engagement and lack of support.

5.3.2.1.1.3. Acceptance

Within fostering, a caregiver is required to be accepting of the child regardless of all those aspects that make them unique and promote self-esteem. The transport nurses demonstrated non-judgmental acceptance of strengths and weaknesses at various stages of the transport process: through the needs of the team; to acceptance of different level of help at handover; acceptance of the patient; and decision making. This was enhanced by role clarity, and co-ordinating roles, which identified strengths and weaknesses of different skills. They accepted differences in practice within the transport team and accommodated them by adapting to their ways of working. They did show non-acceptance also, with regard to responsibilities:

'the nurse is transferring the infusions over, packing and wrapping, putting all the cannulation stuff away, doing the documentation, disposal of the drugs, packing up the theatre sets so there's no sharps, signing off the documents – its everything, and I think we need to balance those roles out' (Francis (1) : lines 134 – 137).

The transport nurses accepted the differing reactions on arrival, and promoted self-confidence through being friendly, approachable, and professional. This enhanced a positive approach and promoted mutual respect, despite the differing levels of help ascertained.

Acceptance of the patient reflected the decision-making process and provided impetus to the transport nurses in preparing the patient for to be in the right place with the right therapy i.e. to optimise and stabilise through optimal fit. The weaknesses and strengths of the referring hospital and patient acuity, determined by the technological clues, perceptual acuity and confirmation or disconfirmation of the profile, did not detract from acceptance, as these were all unique aspects of the situation. Acceptance does not mean passivity. Acceptance enabled the transport nurses to have the capacity to embrace differences in practices and environments that enabled them to rise to the challenge in focusing on the patient, working through differences together with co-operation.

5.3.2.1.1.4. Co-operation

An alliance with other members such as social workers and other agencies involved in the child's welfare, is necessary for fostering. Nursing does not occur in isolation and negotiation occurs within a multidisciplinary team environment. The transport nurse needs to co-operate and communicate

with all the parties involved, in order to effect a safe and effective transport. Role clarity, role adaption, and nurturing are undertaken by the transport nurses to gain co-operation and transport team alliance. The transport nurse is establishing boundaries through negotiation, overlapping with acceptance to enable co-operation. Negotiating boundaries was dependent on the willingness of the referring staff to engage and co-operate and varied with the degrees of preparedness by the referring hospital. The more the referring staff were prepared, then the more control the transport staff were willing to yield, and negotiation of roles was undertaken. Where there was little help and support, the transport nurses were more assertive and took control. Coercion was used if required to get the referring staff to help in the aid of co-operation, sometimes in the face of adversity. Overall, efforts were made to focus on cooperation for the good of the patient, in order to ensure that the patient's journey to the right place was effected, in other words they reached their stable base.

5.3.2.1.1.5. Family membership

Foster carers must also be aware of the role of family membership as dual membership may occur. They need to be able to give support and recognise that this incurs a degree of passage and give support practically and emotionally as the child negotiates between two families. During transport the transport nurse does not become a member of the patient's family at this time as indeed they have little exposure. However, for a brief period they enter an existing family, i.e. the referring staff who have been looking after the patient. Communication is important to try and obtain a picture of the patient, preferably by a formal handover, and enlist aid and support. They enter into this family relationship by acceptance, co-operation, and sensitivity. Although the focus on family membership is not so obvious in transport, acknowledgement to this aspect needs to be made overt as the transport team tries to transcend the various memberships within the referring ICU, and also communicate with the multidisciplinary team involved with the patient. Consistent and sensitive teamwork means that the transport nurse becomes part of the transport family membership, which needs to become cohesive in order to achieve the best for the patient. Whilst the aim in the Secure Base Model is to provide a solid base for the child to develop, the aim of the transport team is to ensure that the right patient reaches the right place, as safely and speedily as possible. Linking the SBM with the transport process shows that there are similarities. However, there is one element that is missing from the SBM, that of vulnerability.

5.3.2.1.1.6. Vulnerability

In the fostering situation the child in care is recognised as being vulnerable, by the very nature of requiring a placement. However, vulnerability can extend to the foster carer, taking on a child without adequate skills, limited knowledge, and may put other members of their family at risk. The social worker is also vulnerable in these situations in being asked to place a child in an emergency which not be the best match at such short notice. Accepting the child in these circumstances therefore entails taking on risks. The transport nurse is similarly exposed to risks at the various stages in the transport process. The logistics of transport require embracing and relying on equipment and technology. Checking equipment, learning from mistakes, and adapting to patient requirements does not mean negating risk, only the possibility of decreasing risk. Browne and Cook (2011), observe that among ICU nurses' there is an inappropriate trust in technology, which may lead to adverse incidents, and vulnerability for staff and patients. The transport nurses all appeared to respect and maintain equipment and acted in partnership with it, explored more fully in Actor-Network Theory. Equipment may fail at any time, but moral agency, belief in technology and an aim to rescue the patient drives the transport nurse to retrieve the patient despite knowing the risks. Exposure to a strange environment, with strange equipment, and unfamiliar personnel adds to the vulnerability of the transport nurse. Although various levels of help and support can be offered all the transport nurses could cite occasions when they were left feeling vulnerable, alone and distanced from the base hospital. To overcome this, they relied on a degree of common sense and a wealth of prior experiences, viewed through a sensitive lens, and an acceptance leading to autonomy. Staff at the referring hospital also experienced vulnerability with being asked to perform unfamiliar practices and increase their already burdened workload. The patient themselves are vulnerable, they are '*more-than-ordinarily-vulnerable*' (Sellman, 2011, p67). However, this inspires the transport nurses to practice protective and fostering virtues in pursuit of maintaining and promoting patient stability.

Availability outlined the transport nurses' moral agency, belief in technology, and the drive to ensure the patient attained a stable base. Constraints of time in preparation and planning and showed how the transport nurse's utilised efficiency in action, profiling, and adapting through checking and acting on information. Sensitivity showed how the ability to view things from a different perspective gave rise to rationalising others behaviour and acting accordingly. Acceptance ensured active participation in being able to project a united and professional view and appreciation of: decision making, levels of help, team working, handover and acceptance. Co-operation operationalised the interdisciplinary working required to attain a common aim. Degrees of control

and autonomy were negotiated throughout the transport process, with the transport team and the multidisciplinary team at the referring hospital. Family membership highlighted the transport nurses flitting in and out of different memberships over time, and the recognition of the transitory process. Vulnerability represented the most poignant moments of the transport process. The transport nurses reacted with common sense and autonomy when dealing with their own vulnerability, they recognised and accepted the notion, and acted accordingly. Fear for the patient's vulnerability invoked moral agency, but recognition of the referring hospitals vulnerability, coupled with sensitivity empowered the transport nurses with caring, sensitivity, recognition of behaviours and empathy. Although not mentioned in fostering literature as a dimension of the secure base, vulnerability is important enough to be recognised and acknowledged. Thus Figure 5.5. shows the Secure Base Model as applied to transport:

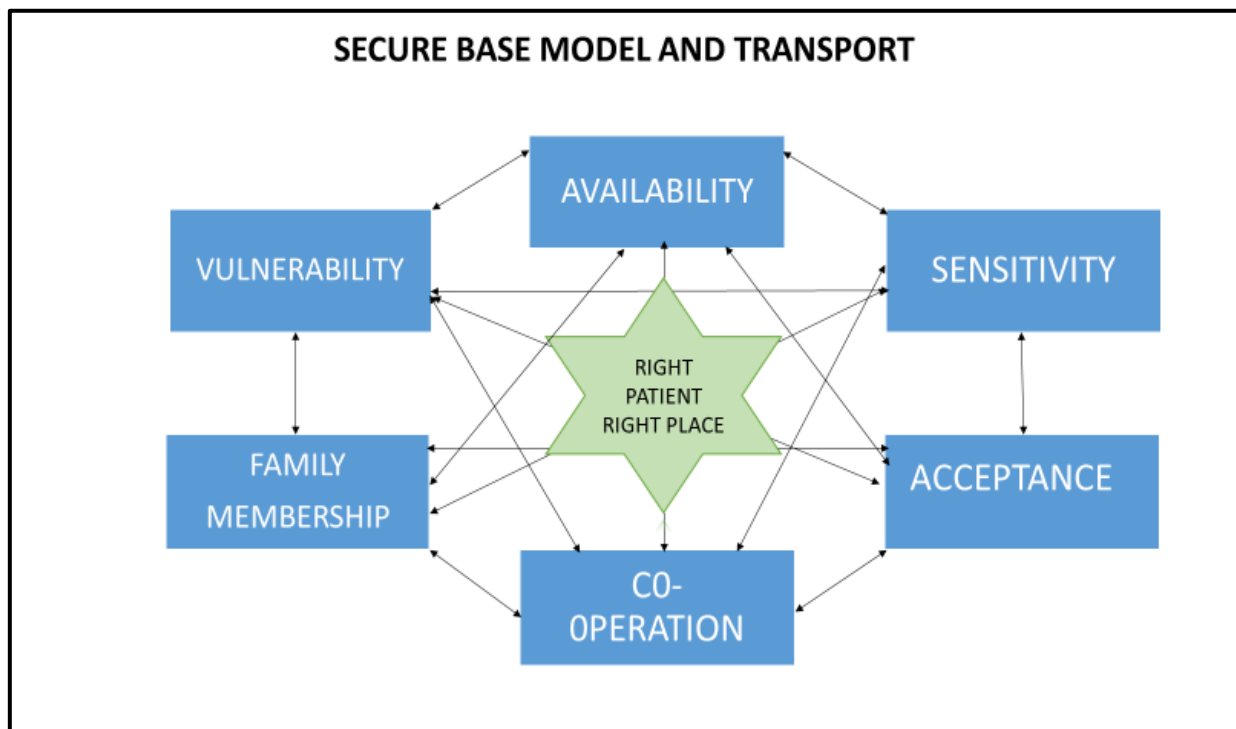


Figure 5.5. Secure Base Model applied to Transport.

The secure base model as applied to transport and the transport nurse's role, makes overt the skills utilised throughout the transport journey. They employ these techniques in order to ensure the

stability of the patient, through: a speedy retrieval; assessing, and employing aid and support through team work; negotiation; co-operation; and utilising resources effectively

This model also makes overt the barriers to successful transport that the transport nurses encounter. Communication was one barrier, with lack of real time information regarding patient acuity, and assessment of communications skills have been tried, with varying degrees of success (Rehim et al, 2017).

Another barrier was the lack of preparation by the referring hospital and a minimal awareness of what the transport team required, resulting in delays in time, and unnecessary interventions such as giving drugs that had already been advised. The transport nurses identified that workload and skill mix may be responsible for this, but also questioned whether the communication was directed to the correct member of staff at the referring hospital. This lack of transport awareness led to vulnerability and risk for the transport nurse. Acceptance of the patient identified a lack of formal handover, instead handover of responsibility transitioned over a variety of times and styles. Lack of engagement at some hospitals led to vulnerability and lack of help and support, despite co-operation and attempts at engagement. Overcoming these barriers would effect a smoother and speedier transport.

What this model did not explain was the relationship between transport nurses and technology. Technology possesses the qualities of transference of negating geographical boundaries (Sandelowski, 1997). Interaction with technology is essential, therefore. The following section delineates the progression of the grounded theory narratives into subcategories and the key category of *Technological Moments*, the concept of the Actor-Network Theory and its application to the grounded theory narratives.

5.3.3. Technological Moments

Safe retrieval of a critically ill patient necessitates a heavy reliance of portable equipment (Mackintosh, 2006), and interaction with technology. Technological moments refer to the transport nurses use of equipment mentally and physically; proactively and reactively; to initiate actions over time. This process ensured the correct and safe intervention for the patient, and informed the nurse about patient acuity and resources. Embracing technology became the driver to initiate the process. Technological moments consist of the subcategories: *Mobilising*; *Technological Crossword*; and *Belief in Technology*.

Mobilising refers to the act of becoming a mobile ITU and shows the preparation that transport nurses take to ensure they have appropriate and functioning equipment, having learnt from previous events, and includes the coding concepts of: *checking; mental mapping; learning from mistakes; and utilising resources*. Technological crossword demonstrates the clues that technology in transport can give with regard to patient acuity and level of care and includes the concepts of: *hard and soft tools; the environment; level of preparation; and level of care*. Belief in Technology explores the reasons for transport nurses undertaking transport and includes the concepts: *belief in ECMO; adversity/risk with technology; and right patient in the right place*.

5.3.3.1. Mobilising

To mobilise the mobile ICU the equipment has to be safe, appropriate to the patient's needs, and accessible. According to the transport nurse's safety comprises: checking; mental mapping; learning from mistakes; and utilising resources. Profiling information ensures the portable equipment meets the patient and hospital needs, and mental mapping of the layout of the equipment means speedier access in an emergency. These actions do not occur in a linear fashion but simultaneously. Checking was the operative word used by the transport nurses in this process:

'Well it starts off with getting the trolley and the bags ready, checking the monitor, the attachments, do I need batteries, are my cylinders full enough, do I take the nitric, what ventilator is there, then I check my bag, does the laryngoscope work, is there enough fluid, do I have the drugs, what is the patients weight for the drugs, etc. If I have enough time I also kind of like to put my hand on everything in the bag so I know roughly where it is in an emergency' (Ellie (1): lines 32 -54).

Checking encompasses both physical and mental actions; ensuring that the transport bags are: fully stocked, functional and patient appropriate; that it will perform over time; and overlaying a 'mental map' for accessibility. Preparation of equipment is a strategy used to allay worries and concerns of transport nurses in the study by Gustafsson et al in 2010, whilst Brewer & Ryan-Wenger (2009), cite operational competency, the ability to prepare and use portable equipment as a domain of skill required for a transport nurse. Senften & Engström (2013) found that careful planning and checking optimised patient safety.

The length of time available to do this depended on a variety of factors such as: time for the ambulance to arrive; time taken to assemble the team; and dealing with equipment malfunction or omissions. The transport nurse has no control over the first two factors, and the third relies on the previous transport nurse having checked and restocked the equipment. Responsibility for this checking therefore lies with the transport nurse at the beginning, and at the end of transport. There is a checklist as an aide memoir for the transport nurse, but exposure diminished the use of the checklist:

'it depends on how experienced you are, I think the checklist on the transport documentation is very useful for the first couple of times, but after that I guess its experience of knowing what you want, what you would like to take with you, and setting it out so that you can put your hand on it if you need it.' (Claire (1): lines 38 -42).

Time and experience led the transport nurses to develop their own routine in this process and also developing economy, by accessing the resources available during the transport journey:

'it's a combination of own routine and the checklist that's on the transport documentation log as well as the checklist that's on the bags and the trolley system itself, I try not to take my own stuff as it leads to duplication, I keep it to a minimum and access everything at the referring centre (Francis (1): lines 48 -52).

Time spent en route involved further mental and physical checking of equipment, and reinforcement of efficiency in time:

'...sometimes check them then (equipment, en route) not so much to make sure they're stocked it's to make sure that I know where things are quickly, so while I'm in the back of the ambulance I have a quick look and sort of try and memorise and note that the fluids are there and this is there, that's there, just so I can get to them quickly' (Penny (1): lines 53 – 70).

Transport nurses learnt from past mistakes. These ranged from omission of equipment, not appropriate to the patient, to equipment malfunction. They actively sought not to make the same mistake again:

'you learn every time you do transport so the next time you are even more prepared' (Linda (1): line 34 – 35).

This drive to avoid repeating mistakes aligns with the right patient treated with the right equipment. They filtered the information down to specifics and changed practice in anticipation of projected need:

'I've changed, I'll make sure that there's a Cordis (IV Introducer) as again I've been in a situation where there wasn't one and it made it a bit difficult' (Ellie (1): lines 46-52).

Preparation and changes in practice did not always meet the transport nurse's situation. Dealing with the unexpected they learnt to think 'outside of the box' regarding equipment and employed resources when, and where, appropriate. Innovation became part of the transport role, with equipment being used in creative but useful ways that were not part of their original purpose. Clamps became drip holders, cold equipment was placed next to a warm body, plasters and endotracheal tape were used to secure items, and:

'once I couldn't find oxygen tubing so we used suction tubing instead, so you have to be prepared to improvise – a bit like Blue Peter really' (Penny (1): lines 211 – 212).

Knowledge of equipment allows a backup plan if another piece of equipment fails:

' I always make sure that I have a spare saturation probe because sometimes the equipment (monitor) fails, but I always know that if I have a saturation probe there's a waveform if all else fails you've got that on board' (Claire (1): lines 50 -55).

Another is to activate all the resources available, including the immediate environment and personnel:

' I always ask the paramedics when they arrive if they have a defib (defibrillator) on board, simply for me, because I don't trust the portable defib because I've had issues with it in the past and I know if I have the paramedics defib on board if my equipment fails I've got a saturation probe on there and I've got an ecg (on the paramedic defib) and can monitor the basics.' (Claire (1): lines 51 – 65).

Transport nurses have learnt from experience that whilst they strive to main equipment, it can fail without warning. It is not their role to nurse the problem or try and fix it. Their philosophy is to take action and consider the whole picture of concern for the patient. Experience and lack of adverse events shows that this action in time is effective:

'You don't know when it's going to fail do you, so what I'm trying to say is that if it happens then you have to deal with it at the time it's not something that you can. I mean if we were to stop and say just think of your monitor went down, or if this went down or that went down, you wouldn't go out and do a transport, so I think these things are unforeseen and you just deal with them at the time' (Anna (1): lines 158 – 163).

The quantitative data from the transport logs demonstrated that there were very few adverse events or incidents. Concerning equipment, one saturation probe was not working, and one novalung fell out as the patient was being transported into the ambulance prior to the journey back to base. There were two CVP lines that were repositioned and resutured, whilst one was not replaced due to alternative access, and an arterial line was resutured whilst in a helicopter. There was only one vehicle incident where a helicopter was forced to make an emergency landing due to engine failure, and the team carried on the journey in a land ambulance.

Preparing equipment to mobilise entails physical preparation combined with mental forethought, projection of action, and mental mapping of equipment. Experiential learning effects changes in practice to meet the needs of the patient. Innovation and creation with regard to equipment and resources, diminishes errors in omission and equipment failure, and fatalism is replaced by action. The transport nurses interact and use technology to the best of its ability to ensure that the right equipment is available for each patient.

5.3.3.2. Technological Crossword.

Transport nurses perform perceptual acuity on arrival at the referring hospital obtaining multiple pieces of information concerning the patient. They are seeking whether the profile is as expected and assessing the patient's current acuity. Engagement with staff and a thorough assessment would give a more complete picture but a variation of engagement, and speed, leads them to seek information elsewhere:

'...you don't often have time to make a thorough assessment' (Francis (1): lines 103).

Walters (1995), found that equipment faded into the background for expert nurses, they 'saw through' the equipment to focus on the information it provided about the patient's condition, but for that to happen a tremendous amount of skilled know how, judgement and knowledge is required. The presence, or lack of, equipment and technology instantaneously provide clues about: patient acuity; the preparedness for the transport team; hospital resources; and the level of care the patient is experiencing, hence the technological crossword. The clues provide overlapping feedback or point to other clues. Fitting the clues together provides information which affects the decision-making process in regard to optimising the patient. The technology that bombards the transport nurses is broken down into 'hard' equipment: the number of pumps, CVVH machines, type of ventilator, and monitoring equipment; and 'soft equipment': types and amount of drugs; availability of extra infusions; patients chart; and equipment used in transfer such as a pat slide/slide sheet. The more pumps there are, then the more drugs that patient is receiving. The transport nurse compares the number and the rate to the original patient profile, and documentation, in order to ascertain if a deterioration has taken place:

'....they were on more inotropes than you were led to believe , or the inotropes were hiked up when you were on your way' (Anna (1): lines 130 – 132).

This visual sweep may confirm that the patient is requiring more drugs than originally thought to stabilise them. The transport nurse then seeks to ascertain if enough drugs are available for the transfer. The amount of infusions available gives clues to the level of preparedness by the referring hospital for the transfer:

'...even though we tell them what we want and what we need you still get there and it's not ready, so if you say can I have enough propofol to get the patient back, can I have enough adrenaline to get the patient back , its generally not done when you get there and you have to give those instructions again' (Claire (1): line 100-103).

Deterioration in patient acuity is accepted by the transport nurses in their knowledge of disease processes and pathology. Inaction in preparation by the referring hospital to respond to this

deterioration, and the need for further drugs leads to frustration as it delays the transport process. Knowing that advice has been given, leads the transport nurses to actively seek clues:

'some of its obvious, -if you've advised them to dry them put and put them on a filter and try this and try that -it's obvious because of all the equipment that's there' (Claire (1): lines 70 – 72).

In the referral advice in the quantitative data, 25% of the referring hospitals were asked to commence CVVH. The transport nurse will be aware of this decision, and as it is a large machine will be able to ascertain at once if it is, or has been, in use. The presence of equipment also reflects on the decision-making process as to the right place for the patient. It alerts the transport nurses to justifying the decision to retrieve for ECMO as the referring hospital have utilised all their resources:

'you can see by all the machines and pumps that they (the patient) are on maximum support and they (the ICU) cannot do any more' (Ellie (1): lines 99 -100).

Putting the clues together the transport nurse then plays an integral role in the decision-making process, as they possess a holistic picture of patient acuity, level of available resources, and the drugs and equipment required for the journey. The transport nurse also gathers clues about the level of care through noting staff interaction with equipment:

' My last couple of conventional retrievals I've been to, I've got there and they've had fairly junior members of staff looking after these patients' eg filter machine: I asked them to wash back the filter machine and they said they didn't know how to do it because they weren't familiar with the machine, and you think well you're looking after one of the sickest patients in the country but if you can't look after the equipment that's attached to the patient then perhaps you shouldn't be there' (Claire (1): lines 112 – 118).

The transport nurses raised concerns about the matching of patient acuity, and level of staff, reinforcing that interacting with technology in order to optimise patient care requires knowledge and competency. They expressed that in an ideal retrieval the clues from technology points to active and competent preparation for the timing of the transport team:

'I would like to see that the advice we've given has been followed, such as Frusemide or cvvh, that they have had a recent chest x ray, and that the drugs we need are there and ready and that the staff are ready and willing to help' (Claire (1): lines 88 -90).

Although the summary of advice given is presented in Table 5.16, it was difficult to quantify whether the advice was acted upon. Checking the retrospective medical records gave some clues from the prescription charts, CVVH documentation and ITU charts, however there was inadequate substantial evidence. Linking advice given with actions undertaken regarding advice was tenuous at best and therefore not presented. However, the clues from the narratives describing the equipment around the space of the acutely ill patient, presented an indication to their: acuity; the environment and resources; preparation and level of care.

5.3.3.3. Belief in Technology

Transport nurses spoke about their willingness to do transport, even if it was on their rostered time off. Initially they aligned themselves as 'crazy' to undertake transport with all the risks involved:

'Well you have to be some kind of crazy dude to go gallivanting off in the middle of the night to pick up the sickest patient in the country' (Penny (2): lines 30 – 31)

They shared a common aim for transport to allow the patient to be in the right place; i.e. an ECMO centre, not only for ECMO but also the other available resources:

'They are obviously out of their depth, the patient is going to die unless we bring them back, okay they may die with us but at least we have the resources to try and prevent that' (Penny (1): lines 71-74).

Faith in the technological resources at the base centre drives their common aim to retrieve the patient. Further narratives highlight the transport nurse's belief in ECMO that compels them to match up the patient with the ECMO machine:

'we need to get them on ECMO' (Ellie (1): line 114).

Their knowledge of, and commitment to, the ECMO machine then becomes the motivation to undertake transport:

'You do it because you like ECMO don't you, you are passionate about it and want to do it, you are driven to it' (Francis (1): line 279 – 280).

even with the risks of equipment and technology failing:

'if we were to stop and think, just say if your monitor went down or that went down, you wouldn't go out and do a transport' (Anna (1): lines 161 – 162).

As with most ICU nurses they also develop common meanings and jargon over time. Integration with ECMO not only motivates, drives, and instils passion, but also creates its own language:

'they are no longer ECMOable' (Anna (1): line 144).

Transport nurses have faith in the equipment through preparation, checking, use of equipment, integrating into their language and common aim. They act and interact with technology, so in turn technology becomes an actor, an influence in prompting their actions, which allows them to carry out their activities in a timely way. Technological moments records interactions the nurses have with technology, the care in preparation, specifying equipment to the right patient, and mentally assembling clues to inform the decision to retrieve the patient, with a common aim to ensure the right patient in the right place at the right time. Next, the Actor-Network theory is introduced and discussed in its application to Technological Moments.

5.3.4. Technological moments in context

Belief in technology sustained the drive to be emotionally and physical available for transport. Planning and preparation for the patient included ensuring safety and appropriateness of equipment. Patient acuity was determined by the presence, or lack of equipment. The preparedness and level of engagement of the referring hospital was observed by availability of tools such as drug infusions, which demonstrated adherence to advice given and the ability to act on requests made prior to the transport team arriving. Technology further provided the tools with which to maintain patient stability

and optimise the patient for consideration of ECMO. Evolving technology and correct utilisation of equipment in a safe manner facilitated the overall transport process of the mobile ICU for the patient.

The grounded theory showed that the complex, but timely, interaction with technology was not limited to equipment, and material objects such as drugs or blood products, emergency equipment, and documentation, all made demands on the transport nurse. Classifying technology into human and non-human (Barnard and Sandelowski, 2001), allows identification of all the technological interactions. Non-human relates to all artifacts, including drugs, documentation, as well as artificial intelligence such as computers and equipment.

Human-technology relationship has been the subject of many debates as technology has increasingly been absorbed into everyday life. Over the past 2 decades there has been an explosion in digital healthcare communication and information, increasing use of technology from clinical records, point of care devices, and evolving diagnostic, treatment, and caring equipment (Almerud et al, 2008, O’Keefe-McCarthy, 2009). Effectiveness of technology on patient care, morbidity and mortality, has been the focus in evaluating new techniques and implementation of new technologies (Peek et al, 1992), and the effect in nursing particularly in ICU, which has been described as an almost fully technological work environment (Browne & Cook, 2011). Technology was propounded as facilitating and improving care through increased safety, reducing the workload of nurses and leaving more time for care. However, others criticised technology for being an additional source of stress with issues in reliability and trust (Almerud et al, 2007a), that technology rather than enhancing patient care became a physical barrier, disrupting communication, and weighting workload towards technological objective measures rather than subjective care (Almerud et al, 2008). The touch versus technology debate prompted research looking at nurse-technology interaction outlined in Chapter two which introduced the concept of the sociotechnical lens.

When applied to nursing research, this lens posits that interaction between human and material objects produces a reality that is complex and nonlinear in nature (Booth et al, 2016). Narrowing the lens further is the innovative and pragmatic approach to nursing research involving humans and technology known as Actor-Network Theory (ANT) (Booth et al, 2016), outlined in Chapter two.

5.3.4.1. Actor-Network Theory

To recap on ANT, this approach has been utilised in disciplines such as planning, geography, history, education, information systems, library sciences, and environmental studies, and is starting

to be used in health sciences. ANT is a theory that gives equal credence to both human and non-human actors. The phrase *actor* is used to denote both human and non-human entities, which are able to perform action, although later studies described humans as actors and non-humans as actants (Sheehan, 2011). Using ANT provides the opportunity to bring the non-human actors into focus under the analytic frame (Whittle & Spicer, 2008). Organising and assembling actors together enable networks between these separate actors to become established, in order to mutually support and accomplish tasks or actions. Determination of the agency and importance of individual actors is established through a process of mutual negotiation called 'translation' (Booth et al, 2016). A stable network is established when the actors align and perform in unison, this is called a 'blackbox', and recognised when the network appears to function as a seamless individual unit, rather than multiple components (Booth et al, 2016). Integral to this singular functioning is the key principle of ascribing meanings to roles and behaviours of individual actions. These 'inscriptions', need to be mutually recognisable and visible to other actors. Inscriptions can comprise of a range of elements such as: technical artefacts, documentation; policies and procedures; routines; and skills, but they can also be equipment (Booth et al, 2016). In this study, the documentation sent to the referring hospital serves as an inscription. It promotes action and contains mutually recognisable requests for drugs and personnel. The checklist on the transport bag is also an example of an inscription. These inscriptions can make action possible even at a distance, so they can transcend time and space. Inscriptions themselves do not guarantee adherence, they may lack flexibility and cohesion. The human actors themselves may consciously, or subconsciously, choose to ignore or alter them, just as the referring hospital may not have achieved part or any of the requests made on the documentation sent by the base hospital. Similarly, not all transport nurses follow the checklist for the equipment bag.

Inscriptions are created by actors in an attempt to attract and mobilise an equal playing field which incorporates both human and non-human actors, to jointly formulate a game plan, realise a strategy, and thus form a stable, secure, and aligned network (Booth et al, 2016). The term network does not denote compulsory paths such as a computer network. Instead, it is rather a tracing of the effect that actors have on each other, an expression of energy (Latour, 2005). Inherent in this view is the concept of viewing these connections as dimensions, boundless and unlimited, and thus society is viewed as multidimensional. This process of increasing alignment within a network to form reciprocal and common interests is called 'translation'. Latour (2005, p 6) describes ANT as the 'sociology of translations'. Translation is the outcome of the process of following and tracing associations,

articulating effects, creating continuity where there may have been discontinuity, where the result is a smoothing of differences and the building and transforming of new relations (Sakari, 2006). Analysing the process of translation demonstrates how any new relations are created, where connections have been made that were previously unconnected, any reconciliation involved, and strategies or steps taken to ensure continuity (Sakari, 2006). Centred within this process of translation are four sub processes:

- problematisation
- interessement
- enrolment
- mobilisation

They describe the process of forming and creating a stable network. Instability can occur at any point in these stages and several factors can affect stability such as agency. Actors possess both agency and autonomy, and the wishes and reactions of the actors may challenge the stability of the network. A shift in alignment between actors can also disrupt, collapse, or misalign what previously might have been perceived as a stable blackbox network (Booth et al, 2016). Similarly, the network may be dismantled by repositioning of actors in favour of new actors (Booth et al, 2016). This process of translation then is both recursive and iterative to take account of shifts in stability and promote fluidity of alignment and reformulation. Translation describes the actions of the transport nurse with regard to human and non-human factors.

5.3.4.2. Problematisation

Problematisation involves the initial planning of the project, identification of actors, and selecting who, and what, is part of the project, to bring together actors with a common aim (Hamilton, 2011). A primary dominant actor or 'gatekeeper', is established between other actors and inscriptions (Booth et al, 2016), whose most important role is aligning and modifying actors, and inscriptions, to their interests. Problematisation begins with the referral of the patient, and the ECMO co-ordinator becomes the gatekeeper to assemble the team for transport, with the aim of a safe and speedy retrieval of the patient. Inscriptions in the form of referral information, are important to obtain patient acuity and selection of appropriate equipment. This information is transcribed onto the transport

documentation and becomes a portable inscription. The ECMO co-ordinator sends the referring hospital a list of resources and equipment that the transport team will need on arrival. This inscription then promotes action from afar at the referring hospital, although as the transport nurses describe this is not always the case:

'perhaps they are too busy or too short staffed' (Helen (1): line 13).

Or sharing of the inscription has not been made available to all at the referring hospital:

'maybe you are not talking to the right person....I think speaking to the nurse who is looking after the patient is paramount' (Linda (1): lines 109 – 110).

Prior inscriptions in the form of policies, procedures, and skills and training are necessary to be part of a transport team. The referral itself is an agent for action, and therefore an actor, as it produces decision making and assembly of other actors in problematisation. Belief in ECMO is demonstrated by both the referring hospital perceiving ECMO as a way of preventing patient deterioration, and by the ECMO base in the willingness to undertake ECMO transport. This non-human actor thus sustains and promotes a desire to maintain and optimise the patient for initiation of ECMO. Advances in technology in ECMO means that ECMO is not only a treatment but has also become a transport system. The equipment checklist is an inscription to ensure uniformity and safety of transport equipment, although as described by the transport nurses this is not always adhered to. However, rather than perceiving this as a negative, the transport nurses' skill and experience negate the need for a checklist. Organisation of the transport bag exerts the action of mental geography as to the location of emergency equipment in a crisis. The location of the referring hospital itself exerts an action of thought and consideration to selection of drugs and equipment:

*'Well if it's a ***** little hospital, if they are not on vasopressin you know making an infusion up and taking it with you in case you need it'* (Ellie (2) lines 5-6).

Transport of the critically ill is fluid by nature and networks formed have to be capable of transcending different environments. The transport nurse undertakes the gatekeeper role once the transport team was physically assembled.

5.3.4.3. Interessement

The next process in translation is to stabilise the identity of the actors through designating a set of interrelated roles and create a new infrastructure. Consideration must be taken of the links

between actors, to ensure the roles are feasible, and strengthen desired links whilst decreasing potential threats (Hamilton, 2011). Efficient transport relies on smooth and efficient teamwork, ensuring not only identification but also clarification of roles, to create a blackbox network. The transport nurse's role identification, role clarity, and adaption of roles, demonstrates this process of intersement:

'we always go through our roles to see who is doing what' (Claire (1): line 51).

The transport nurses spoke of the ease of alignment with other human actors that they have worked with before, but needed experience with new members:

*'I knew what was expected of me, and found I could work methodically and seamlessly...but with ** I didn't know what he expected of me'* (Anna (1): lines 115 – 116).

Discussing roles then appears to be a tool for unification and decreasing the risk of duplication or omission:

'because otherwise you end up with two people doing the same thing' (Ellie (1): line 40).

It could be argued that each piece of transport equipment has a designated role, but skills in transport enable a 'thinking outside the box' approach:

'once I couldn't find oxygen tubing so I used suction tubing instead' (Penny (1): 114).

Also, preparing to align with other non-human actors if circumstances dictate that their designated role was not appropriate any more:

'if a theatre wasn't available for a neck cannulation then we could look at using a different cannula for neck and groin' (Francis (1): lines 75 – 76).

Ensuring feasibility with non-human actors' entails safety and checking of equipment to ensure optimal performance, and learning from mistakes in ensures availability of resources in potential equipment failure:

'I always make sure I've got a working bag valve mask because I had an experience where my ventilator failed' (Claire (2): lines 43 – 44).

In this way the transport nurses decrease potential threats. They seek to interest other actors such as ambulance personnel and equipment, and staff at the referring hospital, enrolling them for the common aim to optimise and stabilise the patient in retrieval.

5.3.4.4. Enrollment

Enrollment is the process of increasing alignment of the actors with their predefined roles in order to be able to enact them (Booth et al, 2016), ensuring that they have the tools to perform. These tools encompass a variety of resources, skills from experiential knowledge, materials, devices, and policies and procedures. This firming and alignment serve to protect the network against possible instability. The main threat to this network occurs on arrival at the referring hospital. The transport nurse perceives quickly whether new actors are available to be enrolled in the network, both human and non-human. Human actors are sought in order to gain patient information, help, and support. Enrolment of these actors may lead to conflict if they try and exert influences to potentially destabilise the network. The transport nurses respond by either accepting or delaying responsibility, or defining and redefining roles for self and others through support and guidance:

'I think that generally speaking I find referring centres to be very helpful, so you walk in and 'what do you want us to do, tell me what you want ' is a lot of them, and I think that a lot of them are occasionally you do get the 'big sigh' and they like to be led and you know sort of chivvy them along if it's not happening' (Anna (1): lines 80 – 84).

In certain situations, the transport nurse will then take control and assign roles to effect a smoother and safer process:

'I delegate, I pick people' (Claire (1): line 219).

If staff at the referring hospital are unwilling to engage or enrol, then vulnerability may occur. To maintain patient stability and optimise the patient, the transport nurse seeks support by giving instructions to non-engaging staff:

'you have to give those instructions to get the drugs you need' (Claire (2): line 103).

The transport nurse maintains the network by not precluding seeking outside help, or utilising resources as tools. They enrol personnel and equipment to effect a speedy transfer, but if instability occurs the transport nurse redefines her role to maintain alignment. With non-human actors the transport nurses enrol technology to gain information about patient acuity, and promote action in preventing deterioration, maintaining stability, and ensuring correct decision making. Assessment on arrival confirms or disconfirms whether inscriptions have been followed. Threats to stability of the

network may cause repositioning of the actors into their individual entities, thus not functioning as a network:

'sometimes for me it's like working in isolation from one another' (Francis (1): line 154).

This occurred when transport nurses reflected on the inequality between roles and responsibilities within the transport team, with the onus of the workload being on the transport nurse;

'you've got perfusion working in isolation, the cannulator (Doctor) going off and going 'we're going to theatre', and you're left there to pack and wrap, change over the monitor, you know do everything else, it seems very fractured' (Francis (1): lines 157 – 159).

Despite inequalities, which the transport nurses commented on, they maintained the stability of the network by professionally performing to their predetermined roles:

'if you go in as a team you stay as a team' (Anna (1): line 111).

ANT is an active cyclical process that when faced with instability or threats, regrouping and redefining roles occurs, and enrolment into the network commences again. If successful, then the next stage, mobilisation occurs:

5.3.4.5. Mobilisation

In the final stage of translation, the network is transformed into a single entity to effect and achieve a common aim, described as where 'the few come to speak as the many' (Hamilton, 2011, p61). A period of reflection may be required to ensure that identified roles are still in harmony with other members of the network. Transport nurses have confirmed that they feel at times isolated but still strive to enrol and engage all the actors within the network, which should be starting to function as a united front:

'I hope it looks really slick, you know coming together' (Francis (1): line 155).

The focus of the transport nurse is also on the silent actor in this network, that of the patient. Mobilisation of allies ensures that maximum help and support from human and non-human actors, are employed in preventing deterioration, and enhancing patient care. This is the goal driving the transport nurse in maintaining and supporting the actor network. A cyclical process occurs in transport. The transport team assemble and work to form a stable network which then undergoes a relocation to a different environment. Attempts are made to enrol new actors. If there is no enrolment,

then the network maintains its own actors to preserve stability. Success of the translation though is not a static end of the process. To transport the patient back to the base hospital, alliances previously made, have to be disengaged as the transport team revert back to their original network. Central to this grouping and reforming is the key drive, that of maintenance of patient stability and optimisation. Success in this equates with a translation in the ANT process. ANT demonstrates that technology has emerged from a social process and can effect a change in the shape and range of social interactions.

Evolution of technology produced ECMO, and more pertinently mobile ECMO. Organisational demands have created the need for a transport team. Policies, protocols, skills and training, have ensured the correct human and non-human actors. ANT demonstrates the gathering of available human actors, from a belief in ECMO, and how the transport nurse coordinated and aligned themselves with human and non-human actors. Extending the network through enrolling new actors at the referring hospital was observed with various degrees of success. The transport nurse was instrumental in aligning and adapting roles and reflecting on threats to instability. Mobilisation ensured utilisation of all actors to achieve a successful outcome. Non-human actors gave specificity to the patient's acuity, and prompted action to enrol drugs, blood, and fluid where appropriate. ANT affords equity of value and acknowledges that human and non-human actors both play an integral role in forming a network to achieve a goal. The use of ANT as a model identified potential barriers to successful retrieval of a critically ill patient, identified through the transport nurses' narratives. Inscriptions arising from referral advice and preparation requests were not reaching the appropriate channels of communication. Lack of enrolment showed the transport nurses carrying on with stabilisation of the patient, but with a change in dynamics, utilising human actors as resources to engage with non-human actors. Delay in handover at the referring hospital identified the transport nurses reflecting on their predefined role, adapting their role, and beginning the iterative process of translation again. Fluidity of the network can therefore be sustained despite contextual variations. Used in this way ANT can transcend time and space. ANT aided the transport nurse in decreasing risks to patient, and provided a deeper understanding of the interaction between human and non-human players in the network.

5.3.5. Acting in Time: Underpinned by SBM and ANT

Acting in time encompasses both theories of the Stable Base Model and ANT as they join together over the patient journey, prompting cognitive thoughts and actions, which enabled the transport

nurse to undertake proactive and reactive strategies in patient stability. The aim of ANT is to ensure that a stable network is established to reach a common goal, through ascribing meaning to roles, thereby promoting alignment and forming mutual interests through translation. The aim of the Stable Base Model is to ensure the correct fit for the patient through the skills, qualities, knowledge, experience, and professionalism of the transport nurse. The goal common to them both is to ensure that the patient is optimised and stabilised as resources allow, to enable them to receive the correct treatment, i.e. the right patient in the right place, and as quickly as possible to prevent deterioration.

Combination of ANT and the SBM seems to be a logical step to address this balance. Comparisons between the elements of two theories did not appear initially to be compatible and attempts to weave them together diluted them both. On reflection, there were two processes working in parallel. The ANT prescribed the stages of translation to form a stable network and achieve a common goal. The Stable Base Model provided the tools or methods, cognitive and physical, to achieve translation. ANT describes the process, whilst the underlying activity, cognition, and strategies, to fulfil the aim, are explored and explained by the Stable Base Model. One places the processes in the foreground whilst the other explains the activity occurring in the background. It is not however, that these two theories or processes work separately, rather that they are reciprocal, complementing and supporting each other in the transport process.

Problematisation, the initial planning, formulation of the team and using inscriptions, relates to the importance of availability in the Secure Base. The willingness to be available, driven by a belief in ECMO, anticipation and preparation, leads to role identification and profiling. Inscriptions such as referral information, documentation, and checklists aid in adaptation to differing needs, as does the gatekeeper co-ordinating and aligning all these components, ensuring the right skills and training according to patient acuity have been obtained, whilst adhering to procedures and policies.

Interessment, overlaps with role clarity and alignment. Sensitivity and reflection aid teamwork through role clarity, co-operation, communication, negotiation and adapting to differing needs. Learning from mistakes, mental mapping, and assigning roles to non-human actors, brings all members of the team together.

Enrollment, is enhanced through acceptance and non-judgmental behaviour, acknowledging strengths and weaknesses, knowledge and resources, and co-operation through clarity and alignment of roles to human and non-human actors. This decreases vulnerability by accepting non

engagement, but utilising resources available. Family membership is promoted through enrolment. Decreasing vulnerability applies equally to the patient as well as the transport nurses.

Mobilisation, the creation of a stable network is increased through the qualities of: sensitivity in reacting to other actors behaviour (human and non-human), acceptance and professionalism in engagement and enrolment, co-operation and coercion in alignment with actors roles, and the ability to form family membership, to become a cohesive and stable network.

Together they enhance the core category of Acting in Time by their united aim, working together through the transport nurse actions in addressing patient stability.

The application of the SBM to transport nursing arose from the grounded theory narratives. This application led to an emerging theory that not only demonstrates nursing skills and actions but also identifies the particular virtues of the transport nurse. Wainwright (1997), and Sellman (2011), have both suggested that there are advantages to be had in understanding nursing as a practice in the MacIntyrean sense, in that it can offer a way to identify professional virtues. Looking at the transport nurses' actions, they all relate to the dimensions in the SBM as applied to transport. It could be argued therefore that these dimensions are in fact the professional virtues that have been identified in this study of transport nurses of: availability; sensitivity; acceptance; co-operation; family membership; and vulnerability. These professional virtues come together with the stages of ANT to achieve a common aim and realise internal goods activity through achieving the standards of excellence inherent in the activity (MacIntyre, 1985). These professional virtues not only overlap with each other but are also integral to achieving the translation in ANT of a secure transport.

The availability to meet the patient needs are required in order to provide stability and build trusted relationships. The ability to meet their needs provides a base and support from which the patient can build the resilience and confidence required to achieve independence and enable them to take some control over their own lives. Availability means having the time also to plan and prepare to respond to the patient's differing needs. This notion also applies within the nursing team itself. Existing and new members would benefit from recognition of their own needs, and that staff or resources required are accessible to them.

Sensitivity, the skill to anticipate and perceive the physical and mental needs of the patient, to understand their emotions and behaviour in a non-judgemental manner is important to gain trust and build relationships. With this understanding comes the ability, in liaison with the multidisciplinary

team, to put into place a plan of care for the patient whatever their circumstances. Acceptance of strengths and weaknesses impacts on both patients and staff. Differences between staff, dealt with sensitively, in a neutral manner, promotes mutual respect and aids teamwork.

Co-operation between nurses and patients is necessary in building a relationship that enables or empowers the patient in achieving their own aim, whether it be maintenance of health, rehabilitation, or palliative care. In order to attain this though, co-operation may require coercion, or at times, assertion. Co-operation also extends to including family members or carers, and the multidisciplinary team in fostering or aiding these relationships. This notion also fosters collaboration within nursing teams and other disciplines in fulfilling their roles in providing a seamless and unified approach to the patient.

When a patient is admitted to hospital, or under the care of a community nurse, care home, they immediately enter into a relationship that may become an extension of their 'family' membership. Here, communication is required to enable clarification of roles within this extended family network. Nurses need to obtain information in order to recognise and acknowledge their patients existing family membership and function within it. With this knowledge then transitioning between the new family and existing family is made easier. Nurses need to identify their role within this membership in a sensitive and consistent way. In a similar way nurses need to foster family membership within their own nursing team.

Vulnerability within nursing is a term that has heavily been focused upon the patient, but as Sellman (2011), points out, human frailty is a common element, and as such he describes patients as '*more-than-ordinarily*' vulnerable (Sellman, 2011, p 67). It is an important distinction as it identifies that all humans at some point are prone to vulnerability. The focus then in the SBM model as applied to nursing is on the professional vulnerability of nurses. It can occur at all stages of their nursing experience, from novice to expert (Benner, 1984). Although understandable as a pre-registration student, or newly qualified nurse, vulnerability also occurs as nurses' progress to take on more responsibility and new roles. Recognition of this within the nursing team is required to be able to directly support those if required through communication, debriefing, simulation, and educational resources. With vulnerability lessons can be learned though, and strategies formed to prevent or diminish the situation in the future. Nurses need to share these to support experiential learning in their own environment.

The application of SBM, as a nursing theory or model, can in future be applied to nursing practice other than transport. Transport nursing is unique in that direct patient care such as hygiene, nutrition, fluid balance, rehabilitation, and to a degree comfort, are minimised in the essential strive for patient safety through enrolling staff and equipment to ultimately benefit the patient. It could however be used wherever patient involvement occurs.

In this study the application of SBM to transport nursing, not only revealed the nursing skills, but enabled translation to be fulfilled, created a stable base for the patient, and reduced the risks of vulnerability

5.3.6. Discussion.

The quantitative data results gave an overall picture of the profile of the patient at three stages in time. Statistical analysis of the physiological parameters showed a statistical deterioration in two out of the eight variables collected: $\text{PaO}_2/\text{FiO}_2$ ratio; and lactate levels, indicating a worsening ARDS profile. The contrasted with the study by Ligtenberg et al (2005), using pre-defined thresholds above which the patient was deemed to have worsened. They showed that although over a third of patients had gone above this threshold showing significant deterioration it was not statistically significant. Markers of physiological change then as a whole did not demonstrate that the patient was deteriorating significantly whilst awaiting the transport team. Anticipation in preparation by the transport nurses revealed that they did expect surprises and disconfirmation of the patient profile from experiential learning.

Scoring systems to evaluate the level of critical illness have been used but not well evaluated, and the Quit EMR Trial (Stauch et al, 2017), has yet to be published, and as Hueng et al (2016) state, scoring systems such as APACHE II and SOFA were not designed for patients with ARDS undergoing ECMO. A relatively new scoring system known as the Respiratory Extracorporeal Membrane Oxygenation Survival Prediction Score (RESP) conceived by Schmidt and colleagues in 2014, through a large-scale study, is being adopted within the ECMO community. It is used primarily though as a survival prediction tool of ECMO treatment in severe ARDS, and not necessarily as a measure of critical illness (Schmidt et al, 2014).

Strategies through acceptance, sensitivity, co-operation and family membership were employed to extend and form new networks at the referring hospital. The reception at these hospitals varied as was the level of preparation indicated by the MRR data and indicated by the transport nurses. Pre transport preparation has been shown to be important in reducing critical incidents (Flabouris et al, 2006). From the referral information 24 hospitals were given advice, a move advocated by Cianchi et al (2018). Although the use of technical clues, transport records and patient notes indicated that some advice had been followed, or not, accuracy in assessing the level of preparation and response to referral advice was tentative at best. Conclusions could not be drawn therefore as a robust method for collecting this data was not used.

Transport logistics showed the distance, time, and type of transport taken to reach the referring hospital and reflects the geographical coverage of the base hospital. This was evident in the low number of air transports compared to countries like Australia where more extensive coverage is required and air transport is the norm (Forrest et al, 2011).

The transport logs demonstrated the activity of the transport nurses in the number and types of interventions at the referring hospital. This was despite barriers such as handover, level of engagement and transition in responsibility. Thirty-eight interventions were carried out during the time spent at the referring hospital (mean of 77 minutes for conventional and a mean of 170 minutes for mobile ECMO). All interventions were made to stabilise and optimise the respiratory and the cardiovascular systems, and to alter the PH and reduce acidosis. The MRR indicated that 64 interventions were carried out by the transport nurse during the transport back to base mainly adjusting inotropes and continuing to correct acidosis to reduce the risks of instability during transport, thus optimising the patient for arrival back at base. Comparison to other studies are difficult as no evidence was found in the literature search documenting this type of information.

Seven incidents were recorded during the transport. Familiarisation with equipment through checking, mental mapping and responding to patient acuity reduced the number of incidents compared to other studies. Lyphout et al (2018), found that 3.7% of incidents were associated with healthcare associated harm. In my study these incidents not found to be of detriment to the patient at the time of arrival back at the base hospital. However, the study by Lyphout et al (2018), was a larger scale study of 688 patient retrievals compared to this study of 50 retrievals. Lack of definition as to what constitutes an adverse event or incident also limits comparisons (Flabouris et al, 2006).

Weaknesses present in these studies that impacted on patient safety were equipment; logistics; communication, and planning and preparation. Acting in Time showed the transport nurses minimising these factors through equipment checking, mobilising the mobile ICU, and profiling the patient in assembling the appropriate equipment. Whilst accepting that equipment failure itself could be a problem, they were confident and competent to utilise the equipment to the best of its ability.

What was revealed from the qualitative data was a core category that encapsulated both cognitive and practical activities of the transport nurses undertaken during constraints of time and space. They described the process of fostering a patient from clinical forethought in the initial profiling, then adapting the profile through optimum fit at the referring hospital, using manpower available, and clinical decision making, to retrieve safely back to base. During this process they also strove to achieve efficient teamwork through anticipation, engagement, adapting and anticipating roles, and awareness of professionalism. The skill of the team was determined by matching patient acuity to team composition, role identification and role clarity established clear responsibilities and actions. Communication and allocation of responsibilities is recommended by Dawson et al (2013), in not only reducing frustration, but also has an impact on patient safety. Cohesiveness of the transport team was also fostered through realigning roles and nurturing. The tracing of inscriptions concerning referral advice, shows that communication may have been lacking. The transport nurses commented on the lack of communication regarding preparation pertaining to transport requests prior to, and following arrival. They acknowledged the pressure that the requests made upon the referring staff but also commented that the information may not have reached the appropriate staff. Mueller et al (2020), note the challenges to communication not only between interhospital transfers but also within intra hospital communication, which reflects the transport nurses observations that key information or preparation requests, were not being delivered to the appropriate staff.

Running parallel with this was the utilisation of technology. In profiling they chose pertinent equipment, while ensuring safety through checking and mental mapping. This profile was confirmed or disconfirmed through the presence, or lack of equipment at the referring hospital, which gave clues to patient acuity, and prompted action, or aided decision making. Experiential learning not only applied to the patient and environment, but lessons learnt from mistakes regarding equipment. Utilising resources then not only applied to staff but also to equipment.

Whilst technological clues assessed patient acuity and level of preparation which were assimilated and stored in cognition, the technical aspect of the transport nurses role was often subsumed by the drive to care. Barnard (2002), argues that awareness of technology is not always at the forefront of the nurses' experience, unless it malfunctions. It can be argued within Acting in Time, both nursing care and technology are important to the transport nurses, and rather than a juxtaposition or dominance, they both work in synergy.

The focus of the patient remained uppermost, driven by the need to retrieve the patient safely, together with caring and compassion, and a belief in ECMO. Transport nurses played a pivotal role in this process. In expressing concerns about the physical appearance of the patient, the transport nurse is recognising that minimal intervention by the referring nurse is linked to patient acuity and instability translating to a risk in transport, aided and confirmed by technological clues. The interview participants were presented with the codes and categories, and comments invited. Transcriptions and memos from this showed that they agreed with the findings but were surprised in finding their cognitive thought processes made overt in this way. The deconstruction, reflection, analysis of the data, and reading, led to the Secure Base Model and Actor-Network Theory to explain not only the influences on the transport nurse during retrieval, but also demonstrated a relationship between care and technology.

Transition of responsibility was unclear, despite ICS and FCIM (2019), guidelines that the responsibility for the patient remains with the clinician at the referring hospital. Physical transition of responsibility differed according to the level of engagement and the type of retrieval. Despite this, the transport nurses continued to engage staff at the referring hospital to form networks in order to achieve optimisation of the patient. Adaptation and realigning roles were undertaken by the transport nurses to match those required in the situation. Formal handover and transition of responsibility remains a grey area, this needs to be addressed to avoid confusion and ensure a smoother handover process.

Leadership was not an aspect mentioned by the transport nurses even though they co-ordinated actions, although Brewer & Ryan-Wenger (2009), identified this as being pertinent to the role of the CCATT. The transport nurses considered themselves as facilitators rather than leaders, which may reflect their position in a multidisciplinary transport team.

The transport nurses, whilst not involved in clinical decision making, expressed advocacy in ensuring the patient received the correct treatment. They did not mention the word autonomy although it was evident from the narratives that they were left alone in certain situations. Instead they relied on their clinical experiences, professionalism and courage, to acknowledge their vulnerability, and utilised human and non-humans appropriately.

Key factors in reducing the risk for the patient in transport are present in the transport nurses' thoughts and actions. Careful planning and preparation of equipment, teamwork, skills in engagement, reducing vulnerability, working symbiotically with human and non-human resources, forming and achieving a common goal, are the indicators to diminish risk and promote safety in transport. In applying the SBM in the context of transport nursing gave a concise summary of the mental and physical skills of the transport nurse.

5.3.7. Chapter Summary.

This chapter has presented the findings relating to the MRR and grounded theory narratives. Acting in Time is the key category arising from the combination of the quantitative findings from the MRR, grounded theory categories, ANT, and Stable Base Model. Acting in Time was shown to encapsulate not only the actions but the cognition of transport nursing in practice. The actions and reactions of the nurse show optimising the patient through: preparation and checking; engaging actors and non-human actors in optimising resources and time; maintaining and enhancing team work through role clarity and role alignment; professionalism in sensitivity and awareness of perception; adapting to changes in patient acuity; and advocacy in directing that the right patient is in the right place at the right time. Maintaining stability is the outcome of all these activities as the transport nurse adapts to not only the work environment, but the constraints, limitations, and vulnerabilities in the transport. The professional virtues of the transport nurse became evident through the application of the MacIntyre approach of what constitutes nursing practice. Acting in Time also highlights the barriers, the blocks that need to be overcome in order to make transport of the critically ill even smoother and safer. Application of the SBM not only provided a framework for the key category of fostering but emerged in its own right as a substantive theory or model of nursing practice and behaviour. It provides a unique perspective from which to study nursing practice, and adds to the sparse literature of the actions, thoughts and perceptions of the transport nurse. The SBM allowed an insight into the professional virtues, or professional phronesis of a transport nurse,

whilst also incorporating an additional virtue of vulnerability. It is envisaged that the fostering model will be transferable to other clinical specialities. Acting in Time is the application of phronesis in a time of adaptation to change, instability and uncertainty, utilisation of resources, and alignment to achieve a common goal.

Innovation in healthcare and centralisation of services have increased the demands for transport of the critically ill patient. Transport literature focuses primarily on quantitative data, but comparisons are difficult due to variations in definitions, geography, team composition, critically ill populations, policies, protocols, and funding. Very few studies have yielded a deep understanding of the role of the transport nurse along the patient journey and their impact on patient care. Acting in Time highlights the lessons to be learnt from transport nurses in optimisation and maintenance of stability of the patient for transport to a regional ECMO centre following referral.

Chapter 6 begins with a precis of previous chapters to summarise the journey through the thesis. Implications for clinical nursing practice are outlined followed by a discussion regarding the strengths and limitations of the study. This leads to recommendations for future research. Planning for post-doctoral development of the study and future publications are also described. Finally, the conclusion summarises the study highlighting the originality of the findings in the field not only of transport nursing but for further specialities.

6.0. CHAPTER 6 CONCLUSION

6.1. Introduction

The tales of the two journeys, the patient and the researcher are nearly at an end, and lessons have been learnt for both. Acting in Time encompassed the SBM and ANT, to explain and understand the actions and reactions of the transport nurses in optimising the patient and maintaining stability. The SBM in its application to transport nursing developed into an exciting theory that identified core qualities and professional practice integral to the work of the transport nurse. The use of ANT highlighted the productive, symbiotic relationship with human and non-humans, co-existing with the application of SBM, in optimising the safety of the critically ill adult for retrieval to a regional ECMO centre. Yet the journey has not reached its destination, which is as yet unknown due to the never-ending nature of research, where answers beget more questions. The study provided answers to the research question, but also highlighted gaps in the transport process that will need to be addressed. The focus of this chapter is to propose strategies to address these omissions in the future.

This chapter commences with a precis of previous chapters to recap and situate the conclusion within the context of the findings. The conclusions drawn from the thesis are answered by referring to the original aims of the study.

6.2. Precis of previous chapters.

Chapter one described the critical incident that was the catalyst for the inception of the study. The historical background of ECMO was outlined, and its evolvement with the advances in technology that made mobile ECMO achievable. The research question was stated, and the aims and objectives of the study expressed. My nursing and research experience then informed the reader in order to place my credibility and suitability to undertake the research in context. The frameworks of the study were discussed using a MacIntyrean approach to obtain insight into the professional virtues of the transport nurse.

Chapter two outlined the literature review to align the significance of the research question to the literature obtained. The chapter was framed to the stages of the patient journey. It began with the outlining the demand for inter-hospital transport highlighting the lack of centralised data of transports within the UK. The rationale for referral for ECMO considered the impact of ALI in ARDS patients, the criteria for acceptance for ECMO and the RCT's undertaken to obtain validation of ECMO. Differences hampered comparison of studies worldwide of the use of ECMO in sample size, case mix, technology, culture, and level of evidence. The hidden mortality, those not referred for ECMO, was also discussed. Decision making with regard both for transfer of the patient and the requirement for mobile ECMO were discussed. Pretransfer preparation of the patient was reviewed, and guidelines from the ICS and FICM (2019), considered. Physiological changes of the patient during transport were studied with varying degrees of statistical significance. Literature about incidents occurring during transport identified both numbers and causes, but a lack of standardised definition made comparisons difficult. Team composition led to the role of the transport nurse. This role yielded little in terms of literature, with only a small number of qualitative studies found. Finally, a review of the literature surrounding fostering and technology gave rise to the Secure Base Model and the Actor-Network Theory. These were outlined and critiques of them given.

Chapter 3 described the philosophical underpinning of the study relating to the research question. Various paradigms were considered, and the rationale for the adoption of pragmatism presented. Under this paradigm, the use of grounded theory, in particular classical grounded theory, was stated and its methodology outlined.

Chapter 4 discussed the methods applied to the methodology; in this study, the use of MRR and grounded theory narratives were used to investigate the research question.

Chapter 5 summarised and presented the research findings, both quantitative and qualitative. The key categories of Fostering and Technological Moments led to the extant theories of SBM and ANT. These key categories and the MRR data informed, enhanced, and were integrated into the core category of Acting in Time. The professional virtues of the transport nurse, which enabled safety in transport and optimisation of the patient were made

overt. The barriers to the safe transport of communication and failure to engage at the referring hospital were identified.

6.3. Implications for Clinical Practice and Education.

The study showed two areas of impact on clinical practice in transport of the critically ill patient, lack of pretransfer preparation of the patient involvement by the referral hospitals nursing staff, and lack of standardisation in documentation and definitions. One implication for clinical practice then lies in raising awareness, knowledge, and skills for nurses of the acuity of the critically ill patient, the effects of transport, and preparation for transport. This should lead to a more confident practitioner either as a transport nurse or as a receiving nurse. The second implication for clinical practice is to establish regional Adult Critical Care Transport teams, with a role to input centralised data to highlight epidemiology issues, enable standardised definitions, monitor adverse events, benchmark, and link with the ICS & FICM, to add to and develop Intensive Care guidelines that are evidence based.

Although actual numbers are not known (ICS & FICM, 2019), with the move to regionalisation, and response to the impact of pandemic events such as COVID -19 (WHO, 2020), there will be an increased requirement for specialist treatment, which will require transport. A requirement that requires a knowledgeable workforce. In line with the Nursing Midwifery and Midwives Council (NMC, Standards of proficiency for registered nurses, 2018), nurses must be able to represent the knowledge, skills and attributes required when caring for people of all ages and across all care settings. In addition, preparation for registration also requires that pre-registration nurses be provided with learning opportunities to achieve the required competencies. (NMC, Standards framework for nursing and midwifery education, 2018), The ICS & FICM guidelines (2019), also advise that all staff who may be involved in patient transport should receive transfer training, educational resources and gain experience in a supernumerary capacity. These guidelines should be allocated more weight as they are based on clinical evidence, expert advice, and feedback from users. The findings of this study highlight that pre-transfer preparation is lacking within some ICUs, whether it be directly pertaining to the patient, or lack of understanding and awareness by nursing staff of what is means to prepare a patient for transport. This study shows that the guidelines are not

being adopted nationally, either in pre-transfer preparation, transport training, educational resources, or experience. A reluctance demonstrated not only by this study, but also the fact that only 13 out of 20 Operational Department Networks (ODNs), responded to a survey by ICS & FICM (2019), attempting to gain a greater understanding of the standards of UK transport practice. This is despite the guide that each critical care network (ODN), should have a nominated lead for transfer, whose responsibilities include referral pathways, transfer protocols, and education and training (ICS & FICM, 2019).

One limitation of the guidelines is that they are not specific enough with regard to training. It appears that the focus of these guidelines is aimed at transfer training for staff undertaking the transfer. Rather the emphasis should be on *ALL* nursing staff involved in transfer, including those at the receiving hospital, undertake transfer training. As not only inter hospital but also intra hospital transport is an increasing occurrence, transfer training should therefore be included in nurse education at various levels. At pre-registration level, there should be a mandatory awareness of the needs for transport too, both intra and inter hospital, to raise awareness of patient movement and understanding of the rationale and procedures accompanying this. Nursing associate programmes are now underway, with accompanying competencies (NMC, 2019). Elements of preparation for transport, roles, and the effects of transport could be included in their learning also, to facilitate knowledge and aid the registered nurse in clinical practice. For post registration nurses in critical care there is the national competency frameworks for adult critical care (CCN3, 2012), with a 4-step process. Steps 1 and 2, both have sections on transport. These are comprehensive sections covering all aspects of transfer from preparation, during the transfer and covering legal and ethical issues. The question is how the achievement of these competencies is accomplished, and where and how these competencies are maintained. The development of regional transport teams, incorporating a rotation from ICUs of critical care nurses would allow these competencies to not only be achieved, but established as a firm skill set. In conjunction with this practical acquisition of skills there is a requirement for these to be founded in evidence-based practice. Therefore, a curriculum needs to be developed to support practice and research in the delivery of high-quality care to these patients. This curriculum could be achieved by forming a Steering Group Committee (SGC), comprised of the Nursing & Midwifery Council (NMC), the Critical Care National Network Leads Forum (CC3N), the Intensive Care Society (ICS), the British Association of Critical Care Nurses (BACCN), Higher Education, Royal College of Nursing, Department of Health, and Healthcare Trusts.

A proposed curriculum is shown in Table 6.1. It describes the different levels of access and study topics covering aspects of transport across differing needs, educational, career, and skill requirements across nursing associates and post registration nurses. It could be achieved through varying degrees of training, including simulation, and the use of technology to deliver teaching such as webinars. Face to face contact within the classroom would also facilitate group case scenarios, one to one tutorial, dealing with sensitive topics such as ethical dilemmas, and increasing the networks amongst students. Involvement with multidisciplinary input would also ensure delivering expertise in the subject, and alternative views and roles within teamwork. The following curriculum is aimed at being an approved course by the NMC, underpinned by the standards for proficiency for nursing associates, and standards for proficiency for nursing and midwifery education (NMC, 2018).

Table 6.1. Projection of a Part Time Curriculum Structure		
Acting in Time: Optimising critically ill adult patients for transfer		
Year and Award	Semester 1	Semester 2
Year 1 PG Certificate 60 credits	The effect of transport on the anatomy and physiology of the patient (15)	Transport equipment, policies and procedures (15)
	Preparation for transport (15)	Human Factors in transport (15)
Year 2 PG Diploma 60 credits	Compulsory: Advanced practice in Context: either: Neuro, Trauma, Toxicology, Burns, Sepsis, Maternal or Cardiac (30)	Choice of: Ethics in Transport (15)
	Compulsory: Research Methods in Practice (15)	Or Advanced leadership skills (15)
Year 3 MSc. 60 Credits	A substantive professional project/research	

The title of the course would be: Acting in Time: Optimising critically ill patients for transfer, which could be accessed at all three levels. It is proposed that this is a part time curriculum, with expectations that students would be able to achieve their competencies within their own workplace or be placed in the appropriate environment. Use of webinars, e learning, and online modules would

also bring this curriculum to an global stage, so that international students could also participate in the courses.

Establishment of regional, dedicated, critical care transport teams would aid in delivering the practical and experiential skills complementary to their formal learning. The aims of the curriculum are outlined in Table 6.2.

Table 6.2. Aims of the part time curriculum	
Award	Aims
Post Graduate certificate in Critical Care Transport	<ol style="list-style-type: none"> 1. To equip students with the knowledge and skills with regard to the effects of transport on the patient in providing safe and high-quality care 2. Develop specialist knowledge and skills in the holistic assessment, planning, implementation, and evaluation of the needs of the level 3 patient whilst awaiting transport. 3. Critically examine current research and practice relating to transport equipment with regard to safety and compliance with national standards. 4. Critically examine the psychological and physiological principles in reducing human error and apply them to improving safety in transport
Post Graduate Diploma in Critical care Transport	<ol style="list-style-type: none"> 5. Develop student's specialist knowledge and skills based on evidence-based practice within their area of expertise, in advanced assessment and plan of care, within national competency frameworks 6. Enhancing high quality level 3 transport care through the promotion of strategies to support improvement in transport practice within adherence to local and national critical care policies and documentation. 7. Develop critical analysis, synthesis, evaluation and application of research within the field of the complexity of caring for level 3 patients requiring transport. 8. Develop student's leadership skills through communication, teamwork, and effective inter professional relationships to meet the needs of the patients and carers. 9. Critically examine, assimilate, and relate to the importance and impact of decision-making judgements, ethics, and ethical dilemmas in the support of transport patients.
MSc Specialist Practitioner (Critical Care Transport)	<ol style="list-style-type: none"> 10. To enable students through the in-depth, systematic, exploration of a specific aspect of transport nursing, to extend their knowledge and skills, and advance and enhance nursing knowledge and practice within critical care.

The next implication for practice would be central co-ordination of established Adult Critical Care transport teams. The first step would be to ascertain within and between the ODNs in critical care,

how far, and in what ways, the application of the ICS & FISM (2019), guidelines and recommendations have been applied. This feasibility study would be the foundation for the implementation of adult critical care regional transfer centres, which have been shown to improve the outcome of critically ill patients transferred between hospitals (Wiegersma et al, 2011, van Lieshout et al, 2016). A Delphi technique to all those involved, the NHS Trusts, the ODNs, the Intensive Care Society, the Faculty of Intensive Medicine, the Department of Health, NHS England, and NHS Commissioners, would then ascertain information and consensus regarding this proposal. The Intensive Care National Audit and Research Centre (ICNARC), the National Reporting and Learning System (RLS), would also be approached to devise ways of obtaining audit data regarding both referral and transport within a central database. PICANet (Paediatric Intensive Care Audit Network), already collect paediatric referral and transport data, which is the basis for assessing guidelines and standards arising from the Paediatric Intensive Care Society (PICS). This adult transport data would form the basis of many types of research at improving and enhancing clinical knowledge, safety, and practice within this arena. Variations in practice would be identified, standardised definitions would enhance comparisons, and benchmarking enabled through annual reports. Communication blocks to optimising the patient were found in this study. Issues with communication and liaison between the base ICU and referring hospitals have already been identified as risks to patient safety (Mueller et al, 2020). Patients are transferred not only between providers of care but also systems of care and settings with a lack of shared information systems (Mueller et al, 2020).

Patient and carer involvement would also give end user experience, a holistic approach in seeking ways to improve adult critical care transport. Collaboration from all the parties involved would be the drivers to maintain and sustain both the education and practice of nurses, and establishment of regional transport centres.

6.4. Strengths and Limitations.

The focus within this study was that of the transport nurse and their thoughts, perceptions and actions. I acknowledge that the transport nurse was part of a transport team, and in no way wish to diminish or minimise the rest of the teams' involvement or contribution. The first strength is that of raising awareness, not only of the transport nurses role, but their contribution to the transport process and nursing as a whole. The transport nurses' role is crucial in inter-hospital transports (Alamanou & Brokalaki, 2014), and their thoughts and actions need to be made overt and acknowledged. The

transport nurse takes responsibility for the preparation and checking the right equipment for the right patient, they assess the patient before transport and take appropriate action while maintaining dignity and respect for all those involved, not just the patient. They foster teamwork and co-operation whatever the circumstance, encourage family membership, encounter vulnerability, while maintaining high standards and vigilance of the patient. Also, they manage and prevent the occurrence of adverse events. Throughout this, they maintain their professional virtues of a transport nurse employing them in endeavouring to deliver high-quality care. This insight has not been extensively studied, and the strength of this study lies in making this nursing contribution to transport articulated and noted, particularly in highlighting and identifying the issues that have arisen within the study. It adds to the body of knowledge regarding transport nursing.

The second strength and contribution to intensive care transport lies in the application of the ANT in the context of the study. ANT demonstrates that nurses and technology rather than being a barrier to care, work synonymously and reciprocally, to achieve the common goal of stabilisation and optimisation of the critically ill adult. Without technology or non-humans, the transport nurse would not be driven to undertake transport, assess patient acuity, nor have the resources to intervene in the prevention of increasing acuity. Without the human element, technology would be dormant and make no impact on the patient itself. The drive to achieve a blackbox effect to benefit the patient shows how technology and nurses work together. The creed of 'following the actor' both human and non-human, was a valuable insight into where barriers or failures occurred to attain the common goal. Once identified, strategies to overcome these difficulties could then be discussed. ANT is more than just a theory of human and non-human interaction, apart from refuting the technology-care debate it can also be used to problem solve, enhance working together in all forms, and provide recommendations for future clinical practice

The third strength of the study lies in making overt the professional virtues, the professional phronesis ensconced with the role of the transport nurse. The adoption of a MacIntyrean approach to look deeper into the complex arena of the practice of nursing led to identifying the virtues as synonymous with maintaining a secure base: availability, sensitivity, acceptance, co-operation, family membership, and vulnerability. It is to be noted that the virtues revealed are only applicable to the role of the transport nurse as these are used to achieve the aim of a safe and stable transport. Adoption of the MacIntyrean approach could, however, be used to examine professional virtues in all aspects of nursing care where nurses strive for excellence in delivering clinical practice.

The fourth strength lies in the emerging concept of fostering obtained through grounded theory. Conceived initially as a gerund to describe the collective actions of the transport nurse over the transport journey, the discovery and application of the Secure Base Model grounded it into a framework and design that could be applied to transport nursing. The application of SBM to an area outside of social work research is new and not been attempted before. The emergence of this substantive theory of fostering applied to nursing is a new and novel theory that has the potential to be developed into a mid-range theory. Taking the essential components of the skills required of a foster carer; the availability, sensitivity, acceptance, co-operation, and family membership, they translate into the skills required of any nurse in practice. The parallels and similarities between nursing and foster carers shown in chapter 5 lends itself to this translation. The application of fostering could then be applied to various sectors of nursing within critical care, such as the patient stay within intensive care, coronary care, renal units, assessment units, heart transplant centres, and paediatrics to name a few. Alternatively, this model could also be applied to palliative care, where these skills and qualities would also be applicable. What makes this model unique and pertinent is this inclusion of the skill or acknowledgement of vulnerability. The honesty of the transport nurses in their interviews outlined scenarios where they did indeed feel vulnerable, and it is worth acknowledging that this feeling is not unique to this scenario. It is encountered along the novice to expert continuum daily in various forms, from the first placement, to not having the right resources, or aid in managing a patient. What arose from the narratives was these experienced nurses did not take vulnerability passively but adopted strategies to deal with this, a professional virtue of the transport nurse. The ability to deal with vulnerability led to it being included in the model. The application of the SBM into other areas of nursing practise should be considered as an emerging theory in nursing behaviour.

The fifth strength lies in the choice of methodology. It is to be acknowledged that within research and nursing research, positivism, the value free, systematic, and objective view of the world, dominates in its ability to be the 'gold standard' of evidence-based guidelines, and a leaning to establish scientific nursing knowledge in its own right (Playle, 1995). The pragmatic approach in this study allowed both quantitative and qualitative research, under the framework of grounded theory, to be utilised. The surgency of mixing of methods however, has come to the forefront of nursing research as a means of obtaining valued outcomes of understanding, thick description, explanation, prediction, and a way of gaining useful answers to the research question (Weaver & Olsen, 2006).

Guidelines based on evidence do not necessarily translate to action, but this mixing of methods has been shown to improve practice and improve practice through delivering situational and contextual answers. As such the promotion and advancement of nursing practice goes beyond the boundaries that positivism is constrained by. As such, this study adds not only to nursing practice but promoted the adoption of different stances or viewpoints, which add to the wealth of knowledge surrounding 'what nurses do'. In addition, the study has highlighted areas for improvement, and conceived strategies for this, through learning from the transport nurse's ability to optimise and maintain patient stability during transport. It also adds to the value of qualitative research into nursing practice. The next section considers the limitations of the study.

With regard to the MRR data, there were two factors, the size of the sample could be considered small in quantitative dataset terms and could have impacted either negatively or positively on the significance reached within the study. The number though was representative of a year's worth of admission to a regional ECMO centre, the sample was not being divided into two or three groups and tested on outcome measures, and was comparable with other sample sizes within the literature (Gebremichael et al, 2000, Forrest et al, 2011).

On analysis of the qualitative sample, there was a mixture of both conventional ($n = 33$), and mobile ECMO retrieval ($n = 15$), and 2 cases where continued instability converted a conventional to a mobile ECMO retrieval. This difference made data analysis initially difficult as patients were not all equal on the journey back, so the physiological parameters on arrival at the base hospital were omitted in favour of the immediate parameters immediately before ECMO for equality. Statistical analysis was then adjusted. Future study in this area would ensure parity among the sample population studied.

The use of MRR relies on adequate documentation, and as such, relies on human willingness. Omissions in the data analysis form meant that the participant was then excluded from the study and a new participant selected. Fortunately, this was rare, but it did mean further time spent in tracking down notes. The use of electronic documentation would have made this process easier. The transport log relies on free text to report any untoward incident. Lack of definition and agreement, as with all recording of incidents may have led to under-reporting.

The qualitative sample was small, but this number was achieved when theoretical saturation was reached, re-interviewing and group interviewing did yield valuable data. One limitation concerning the qualitative sample was not the size but the perspective. The original aim was also to interview the named nurse looking after the patient at the referring hospital, to obtain their thoughts, actions and concerns while awaiting the transport team. This would have given a more holistic picture within the study, and provided information about resources available, skill sets, and an indication of policies and procedures informing patient care. Ethical approval proved too difficult an obstacle to surmount at the current time as an ICU within the UK could refer at any time, and blanket ethical approval was not available. This perspective is worth exploring in future research.

6.5. Recommendations for future research.

This study attempted to reveal the transport nurses cognitive and physical actions through grounded theory that impacted on maintaining stability and optimising the patient for transport. As such I produced a theory grounded in the data which provided explanatory power regarding the focus of the study, which was transport nurses. This is a substantive theory, which means that it is a theory produced for the purpose of comprehending a corporeal phenomenon within certain criteria such as environment or situation (Glaser & Strauss, 1967). To elevate a substantive theory to a formal theory requires applying it to a number of further substantive areas in order to gain a higher level of abstraction and generalisation of concepts (Charmaz, 2014). Future research is then recommended in the following areas in order to try and attain a higher conceptual level.

It is proposed that a similar study should be undertaken initially in Europe in areas that have regional ECMO transport teams, and also military transport teams, to obtain evidence as to whether dedicated teams experience the same barriers in pre transfer preparation and communication issues, variation in definitions, lack of standardised data, and a variable level of handover. Comparisons of the key categories and concepts could also be compared to identify whether Acting in Time applies and survives in different transport environments. If the theory was confirmed or enhanced, then further study could be applied internationally to larger geographical areas such as America and Australia.

The application of the SBM to alternative arenas in nursing practice would measure the strength and validity of the model itself, whilst illuminating professional virtues within those spheres. These could include renal dialysis units, end of life care, coronary care, critical care, and palliative care.

Recommendations for future research are also directed by addressing the unresolved questions and important gaps in the evidence put forward by this study and addressing unresolved questions and important gaps. The study demonstrated the lack of communication between hospitals, which is thought to contribute to poor patient outcomes (Mueller et al, 2019). Further research is required, and the use of ANT could explore more fully the pathway and influence of inscriptions, their role in the transport process, and the feasibility of checklists. Lack of pre-transfer preparation, although difficult to quantify, was of sufficient occurrence to be noted by the transport nurses. It was reflected by a lack of adherence to the ICS & FICM guidelines (2019), and unfamiliarity with pre-transfer preparation of the patient.

With the focus on the gaps and omissions identified within this research, the first step would be to undertake a feasibility study to the ODN's as to the adoption of the ICS & FICM (2019), guidelines that have been proposed to facilitate safe transport. A previous survey by the ICS & FICM (2019), demonstrated that of the 20 ODNs, only 13 responded, and information was missing or unknown. The formation of a Steering Group, as outlined in section 6.3, involving the ODN's should be a driver in obtaining this information. The Delphi technique would then obtain expert based knowledge, predict risk and opportunities, and choice of the development of regional transport teams and central co-ordination of data.

Evaluation of the proposed curriculum and its impact on nursing practice with the outcome being to benefit the patient experience requires a mixed method approach. Collation of the number of competencies achieved can be collected by a survey design. Feedback from the students by questionnaire, whilst subject to a certain non-response rate, can offer insight into further areas that need to be explored. Simulation in a time series analysis, such as that used by McConnell-Henry et al (2015), could be used measure the impact of formal learning and supervision in observing changes in the experiential skills of the student. In conjunction with the latter, grounded theory narratives would again yield a depth of description that would add to breadth of the time series analysis.

Finally, the inclusion of patient involvement groups is necessary. A quantitative survey and interviews using content analysis would consider the psychological, and social impact of transport and gain understanding of their experiences. This would enable improvements in minimising distress potentially caused by patient transport.

6.6. Post-Doctoral Research Timetable.

The findings from this thesis were used to identify implications for clinical practice and education. These implications, together with the recommendations for future research, and noting the strengths and limitations of the study, I have outlined a proposed 5-year post-doctoral research timetable shown in Table 6.3.

Table 6.3. Timeline of Post-Doctoral Research.				
July 2020	July 2021	July 2022	July 2023	July 2024
Feasibility study to ODN's	Consolidate findings and initiate Delphi technique			
Form steering Group Committee	Design and Plan, Regionalised Critical Care Transport Teams and central co-ordination of data		Questionnaire and Survey on impact of transport teams. Publish annual report on transport data. Survey and interviews on the patient experience.	
Form working group to develop standards and competencies for Transport of the Critically ill patient	Launch Post graduate diploma, certificate and MSc programme for Transport of the Critically ill patient		Evaluate programme through collated data and time series analysis	

Publication of findings from this research will also be disseminated. These will comprise of:

1. Literature Review	Discussion paper
2. Methodology	Discussion paper
3. Results	Quantitative Research paper
4. Results	Qualitative Research paper
5. Acting in Time	Discussion paper

6. Application of SBM – fostering model applied in nursing Discussion paper
7. Application of ANT - technology versus care. Discussion paper

The medium for dissemination will be: British Association of Critical Care Nursing Journal, Nurse Researcher, Health Services Journal, Journal of Advanced Nursing, Nursing in Critical Care, Nursing Philosophy, perfusion, Intensive Care Medicine, and Intensive and Critical Care Nursing.

In additions abstracts and posters for presentation for conferences such as BACCN, Extracorporeal Life Support Organisation (ELSO), will be submitted.

6.7. Chapter Summary.

This study set out to critically examine the thoughts, perceptions, and influences on the actions of the transport nurse during transport to maintain stability and optimise the patient for transport. The aims of the study were:

1. *To critically examine the thoughts, perceptions, and influences on the actions of the transport nurse during the transfer process, from referral of the patient, preparation for the journey, and the journey itself.*
2. *To examine any barriers to optimisation of critically ill adults for transfer to regional ECMO centres,*
3. *To identify strategies to overcome any barriers in order to make any transport more of a seamless and efficacious undertaking.*
4. *To identify lessons learnt and make recommendations for future transport*
5. *To add to national guidelines/standards in enhancing patient stability during the retrieval.*

The first three aims were achieved through the utilisation of grounded theory through MRR and narratives. The emergence of the application of the application of the SBM to transport nursing demonstrated the qualities the transport nurses possessed and implemented in ensuring a safe and efficacious transport journey. Together with ANT, in following the actors, and according equality between human and non-human, the key category of Acting in Time arose and together they

accounted and explained the thoughts, perceptions and actions of the transport nurse. Acting in Time also highlighted barriers to optimisation and in doing so strategies to overcome these were considered.

The fourth aim was achieved through the lessons learnt from Acting in Time, and together with current literature concerning guidelines and policies, recommendations for future transport were made. These were, the establishment of regional transport teams with central co-ordination and the creation of a database for adult transport, and the promotion of further education through established programmes for all nurses involved in adult critical care transport. These two recommendations will create an arena in which clinical governance can operate, standards created, and equip nurses with the specialist skills and knowledge to effect a safer transport and decreasing the opportunity for adverse events. This will then achieve the fifth aim of adding to national guidelines and standards in enhancing patient stability during transport and improve patient care. In addition, the education and training of all nurses involved in transport will add and enhance standards of post registration nurses caring for the patient for retrieval. Thus, a higher quality of care will be delivered and so fulfilling the aim of all nurses to provide 'compassionate, evidence-based, and person centred' professional practice (NMC, 2018, p2). The aim of the Doctorate in Health Sciences (DHSci), was the desire to improve clinical practice within the workplace. Application of the issues raised within this study will achieve this aim. In addition, as nurses, there is an ethical obligation to raise concerns when perceived threats to patient safety are discovered. Whether the safety threat is due to personal differences in values and beliefs, or due to a systems flaw failure, identifying and addressing problems is part of the nurses' ethical responsibility. It is important to bring attention to this influential role of the nurse to spearhead practice improvement initiatives.

This chapter began with a precis of the previous chapters in order to summarise the study from the initial research question through to the findings. Implications for clinical practice and recommendation for practice development were made. The strengths of the study were discussed with the focus on the originality of the findings. The limitations acknowledged inequalities in data collection and the difficulties within MRR audit data. The aims of the study were then revisited highlighting what could be concluded from the thesis. Recommendations for the future research, a post-doctoral research timetable, and future publications were then stated.

Much has been learnt during this tale of two journeys, the patient and the researcher, but it is not the end. Instead it is an acknowledgement and appreciation of the role that transport nurses have in relation to patient safety, now and in the future, and the beginning of a new venture to increase safety through centralisation, education, and training in transport for the benefit of the critically ill adult.

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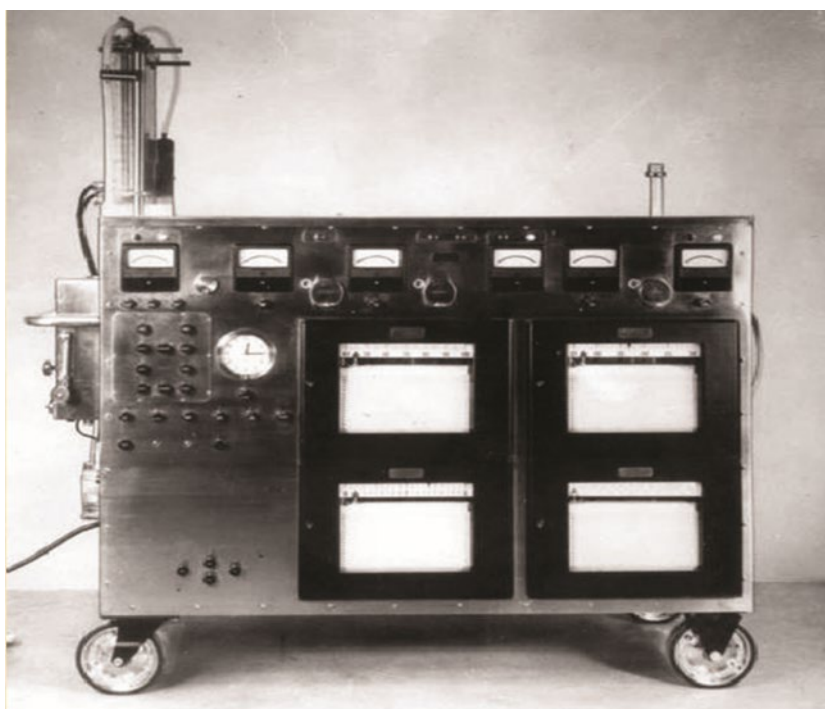
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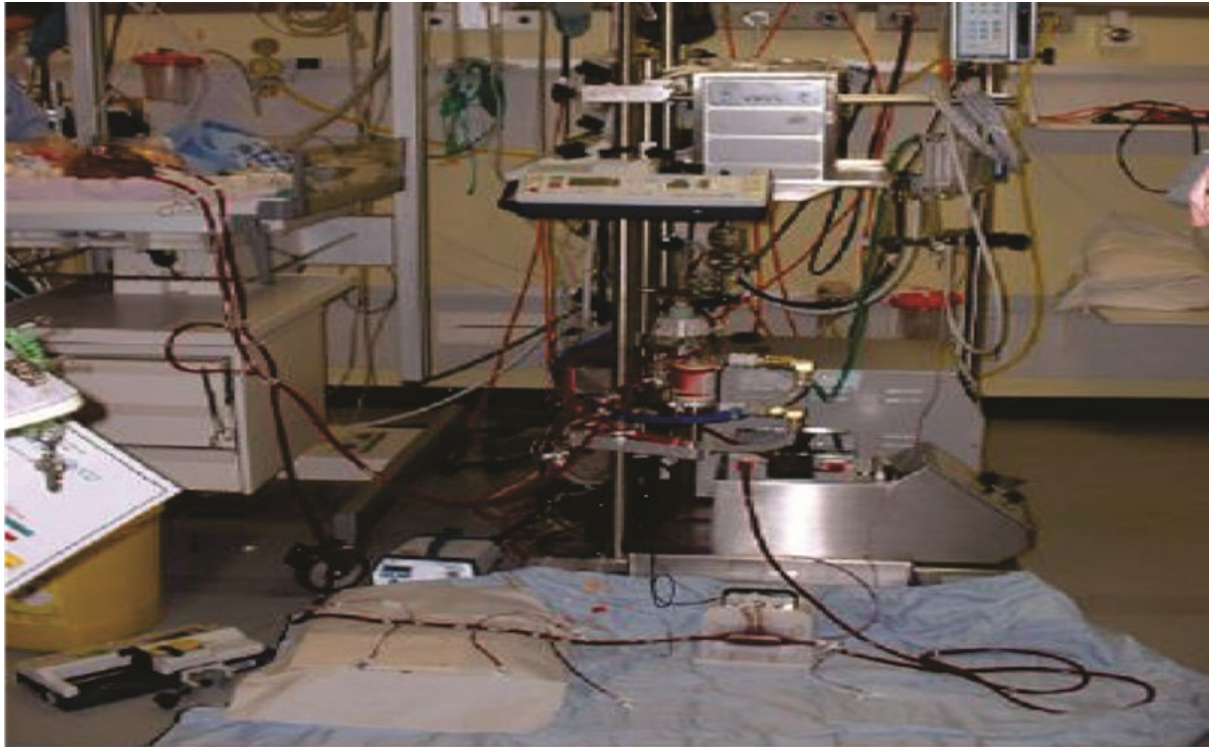
APPENDICES

APPENDIX 1. EVOLUTION OF ECMO.



The original extracorporeal machine (Database ID, Art/Photo Collection, Thomas Jefferson University Archives, Philadelphia, PA).

APPENDIX 2. EVOLUTION OF ECMO PRE AND POST 2009.



The ECMO circuit with roller pump pre 2009 (Harvey.C. June 2008)



The ECMO Circuit with centrifugal pump post 2009 (Palmer. L. July 2015).

APPENDIX 3. ECMO MOBILE TRANSPORT TROLLEY.



ECMO Mobile transport trolley (Harvey.C February 2011)

APPENDIX 4.RAF HELICOPTER.



RAF Sea-King Helicopter (Palmer.L. October 2008).

APPENDIX 5. TRANSPORT HAZARDS.



The Joshua Scarlett Ambulance having broken down. (Harvey. C. June ,20



Land Rover having flipped over in front of the ambulance (reproduced with kind permission of Harvey.C. June 2014)

APPENDIX 6. FIXED WING.



The author in a fixed wing aircraft with patient on mobile ECMO (reproduced with kind permission of the patient, Palmer. L. December 2014).



Demonstrating how narrow the width of the fixed wings doors can be (Harvey. C. April 2013).

A: ET Tube Oral / Nasal size:

B: Ventilation Mode: CMV / PC PS / SIMV / BIPAP / HFOV Other: _____

Nitric Oxide: PPM _____ Proned: Y / N

Settings: PIP _____ PEEP: _____ Rate: _____ FI02: _____ %

TV: _____ Compliance: _____ MAP: _____ I:E: _____

Chest X-Ray: _____

ET Secretions: _____

Chest Drains: Y / N

_____ ABG's: Ph:

_____ PO2 _____ Pc02 _____ Bicarb: _____ BE _____ Sats: _____

OI: _____

Cord Sample :

Vein Ph: _____ PO2 _____ Pc02 _____ Bicarb: _____ BE _____ Sats: _____

Artery Ph: _____ PO2 _____ Pc02 _____ Bicarb: _____ BE _____ Sats: _____

Other: Hb: _____ WCC: _____ CRP: _____ Platelets: _____

Blood Sugar: _____ mmols

C: HR: _____ BP: _____ CVP: _____

Resuscitation required Y/N

Face mask oxygen ☐ Mask ventilation ☐ ET tube ventilation ☐ Cardiac massage ☐

Resuscitation drugs given?

Inotrope 1. _____ Mcg/Kg.Min _____

Inotrope 2. _____ Mcg/Kg.Min _____
Inotrope 3. _____ Mcg/Kg.Min _____
Inotrope 4. _____ Mcg/Kg.Min _____

Cardiac ECHO Y /
N: Report:

Urea: _____ Creat: _____ Sodium: _____ Potassium: _____

Urine Output: _____

Since Admission: _____ Mls Fluid balance Last 24 hours: _____ Mls

Maintenance Fluids: _____

Nutrition: _____

D:

Apgars@ 1 min: _____ Apgars @ 5 Min: _____

PEARL at time of referral: Y / N

Intracranial Bleed Y / N

Cranial Ultrasound: Y / N:

_____ C.T.: Y / N:

Evidence of fits?

Sedation 1: _____ Mls/Hour (Mkg/Kg/Min) _____

Sedation 2: _____ Mls/Hour (Mkg/Kg/Min) _____

Sedation 3: _____ Mls/Hour (Mkg/Kg/Min) _____

Sedation 4: _____ Mls/Hour (Mkg/Kg/Min)

_____ **E:** Sepsis Antibiotics:

Antibiotic 1: _____ Date Commenced: _____

Antibiotic 2: _____ Date Commenced: _____

Antibiotic 3: _____ Date Commenced: _____

Antibiotic 4: _____ Date Commenced: _____

Positive Cultures/Growth: _____

LFT's: B Rubin: _____ Alk Phos: _____ ALT: _____ ALB: _____

COAG: INR: _____ APTT: _____ PT: _____

F: Skin Integrity: _____

Pressure Areas: _____

Any Other Skins Problems: _____

Number of Organs failed: _____

Contraindications to ECMO: _____

Any other relevant Drugs: _____

Lines: _____

274

Blood Group: _____ X Matched: Y / N

Mother's obstetric history

Mother's date of birth: _____ How was this baby delivered? _____

Coordinator: _____ Consultant: _____ Fellow: _____

Bed Available: Y / N Transport: _____

Ascent / Consent: Y / N

Notes & X rays Copied Y / N

Blood X Matched and Form Included: Y / N

Maternal blood from Mother: Y / N

Eligible for NEST? Y / N

Plan / Outcome / Advice by whom?



APPENDIX 8. TRANSPORT LOG

ADULT ECMO TRANSPORT LOG
ECMO CENTRE GLENFIELD HOSPITAL
Tele : 0300 303 1573 (Switchboard) ECMO



Call CenTre: 0300 300 3200 Date:

Patient Details

Name:
D.O.B:
Weight:
Allergies:
NHS No:

Relative Contact Details

NOK Name:
Relationship:
Contact No:
Other Contact Name:
Contact No:

Referring Hospital: _____ **Post Code:** _____

Hospital Entrance for ITU:

Referring Consultant: _____ **Direct Number:** _____

ECMO Duty Co-ordinator: _____ **Contact No:** _____

ECMO Duty Consultant: _____

Admission Diagnosis
Secondary Diagnosis
Brief summary of illness

Please complete all sections

Name of Transport Provider / Trust	Job Number	Time of Booking	Time of Arrival	Type of Transport

Please complete all sections

Time called at home	Time Ambulance Arrival	Time depart from GGH	Time arrive at referring hospital	Time spent wrapping & packing	Time depart from referral unit	Time depart referral hospital	Time back at GGH
Transport Personnel							On Duty Y / N
Transport Cons							
Transport Nurse / Specialist							
Perfusionist							
Trainee / Other							

Pre-Departure Checklist

Road Retrieval

Transport Trolley Connected to Mains Power

☐

Appropriate Size '5' Point Harness

☐

- Adult
- Paediatric/Neonatal

☐
☐

Dash 3000 Monitor – Checked & Operating

☐

Spare Dash 3000 Batteries x 2

☐

Dash Leads attached to Monitor

☐

Patient Ventilator Clamped to Trolley – Checked & Operating

☐

Ventilator Specific Ventilator Tubing	<input type="checkbox"/>
If Oxylog Ventilator – Spare Battery Checked <input type="checkbox"/>	<input type="checkbox"/> ‘6’ Alaris Infusion Pumps – Full Power Level
Full ‘E’ Oxygen Cylinders x 2	<input type="checkbox"/>
Air Retrieval	
Vacu Mattress & Vacu Pump	<input type="checkbox"/>
Alphin Light Stretcher (Optional)	<input type="checkbox"/>
‘6’ Braun Pumps – Full Power Level Checked.	<input type="checkbox"/>
Power Lead for Braun Pumps	<input type="checkbox"/>
Dash 3000 Monitor – Checked & Operating	<input type="checkbox"/>
Spare Dash 3000 Batteries x 2	<input type="checkbox"/>
Dash Leads attached to Monitor	<input type="checkbox"/>
Patient Ventilator Clamped to Trolley – Checked & Operating	<input type="checkbox"/>
Ventilator Specific Ventilator Tubing	<input type="checkbox"/>
If Oxylog Ventilator – Spare Battery	<input type="checkbox"/>
Full ‘CD’ Oxygen Cylinders x 2	<input type="checkbox"/>
‘Red’ Trolley Bag	
Contents Checked Against Internal Compartment List	<input type="checkbox"/>

‘Black’ Case Trolley

Contents Checked Against the Internal List ☐

Contents Verified by the Cannulating Consultant ☐

Neonatal / Paediatric Transport Red Bag

Contents Checked Against Internal List ☐ **Extra Equipment** iStat Gas Analyser and Cartridges ☐

Portable Suction Unit – Checked & Operating ☐

HeartStart Defib – Checked & Operating ☐

Extra Security Straps ☐

Drugs & Infusions

‘Red’ Crash Drug Box (Adult) ☐

Neonatal / Paediatric Crash Drugs ☐

Bolus Heparin for Cannulation ☐

Circuit Heparin Infusion ☐

Antibiotic Cover for Procedure ☐

Documentation Pack

Contents Checked Against the External List ☐

Preceptorship Competence Documents ☐

Patient Comfort

Adequate Sheets & Blankets



Signed by: (Transport Nurse)

Signed by: (Transport Doctor)

Drug Infusions at Referral and any Changes during Transport

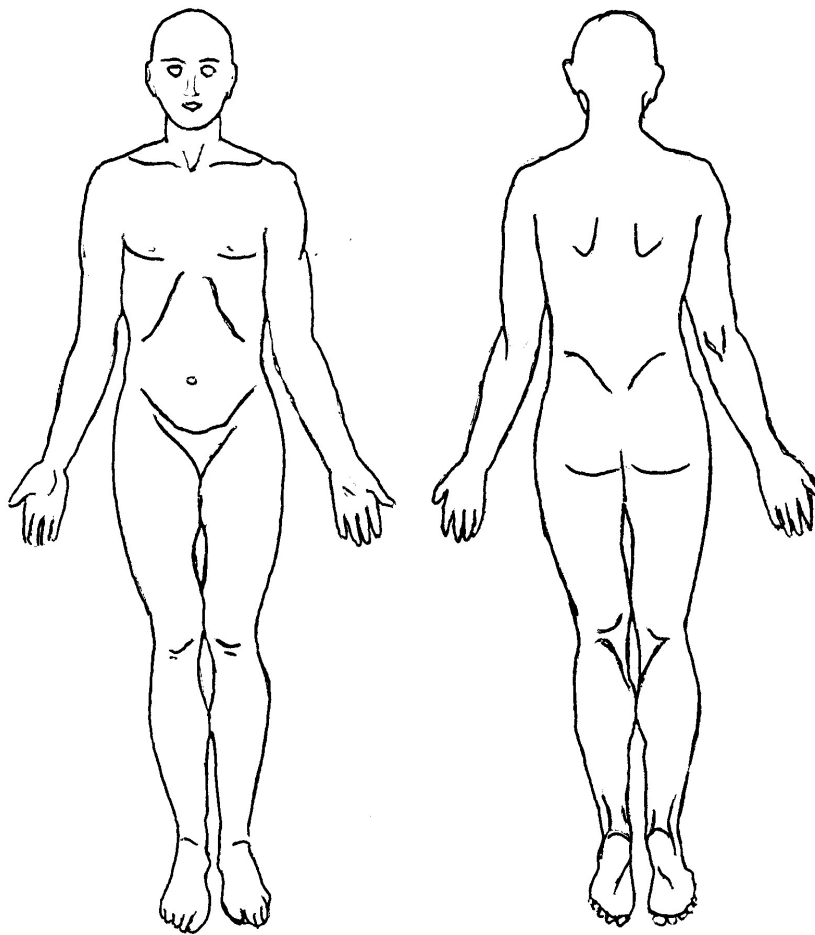
Sedation / Drugs	Amount	Dilution Fluid & Total Volume	Rate (mls/hr)	mcg/kg/hr

Boluses Given at Referral Hospital and During Transport

Time	Drug	Bolus Amount	Reason

Fluids

Time								



ETT Size:

**Central lines
PAP**

Venous Lines

Arterial Line

Chest Drains

Vas-Cath Size:

Catheter Size:

NGT Size:

Capillary Refill

**Colour/Warm
Pedal Pulses**

Pupil Reaction

Pressure Points

PLEASE USE THESE DIAGRAMS TO DOCUMENT Site and **Date of Insertion:
All IV access, chest and drainage lines, any surgical repair sites, trauma injuries,
skin damage.**

**Using UHL Tissue Viability Body Map Document Wounds/ Pressure Area Sores (graded)
Prior to Departure. Datix On Return.**

ABGS**At Time of Referral**

Time	pH	PaO ₂	PaCO ₂	HCO ₃	BE	SaO ₂	Hb	Glucose	K+	Lactate

Prior to Departure from Referral Hospital

Time	pH	PaO ₂	PaCO ₂	HCO ₃	BE	SaO ₂	Hb	Glucose	K+	Lactate

During Transport

Time	pH	PaO ₂	PaCO ₂	HCO ₃	BE	SaO ₂	Hb	Glucose	K+	Lactate

On Arrival at Receiving Hospital (Please State) :

Time	pH	PaO ₂	PaCO ₂	HCO ₃	BE	SaO ₂	Hb	Glucose	K+	Lactate

Vent Settings

TIME	MODE	PAW / AMP	PEEP / MAP	Rate / HZ	I:E / IT	TV	MV	FiO ₂	Nitric PPM

Cardiovascular Observation

Chart Key	Pulse	BP s/d	BP Mean	Sats	Temp (c)	Temp (P)	
Temperature (36.1 – 37.4°C)	Time						
	40						
	39						
	38.5						
	38						
	210	37.5					
	200	37					
	190	36					
	180	35					
	170	34					
Pulse (BPM) / Blood Pressure (101 – 199mmHg) O2 Sats 20% -100%	160	33					
	150	32					
	140	31					
	130	30					
	120	29					
	110	28					
	100	100					
	90	90					
	80	80					
	70	70					
	60	60					
	50	50					
	40	40					
	30	30					
	20	20					
	10	10					
	0						

Blood Transfusion Record

Blood requested for transfer: Yes ☐ No ☐

Number of Units: _____

Blood transferred with the patient (Packed & Sealed by Blood Bank)

Yes ☐ No ☐

Name

Signature

Blue Lights

No Patient Yes ☐ No ☐ With Patient Yes ☐ No ☐

Reason for Blue Lights

Untoward Events

Brief Detail of Event

Incident Form

Completed Yes ☐ No ☐ Datix Reference No :

Transport Audit Form Complete and Returned to the Purple Box File in the Ecmo Fellows Office

Yes ☐ No ☐

Please file this Transport Log in the Patients Case Notes.

APPENDIX 9. DATA COLLECTION TOOL

Case Number

1. Referral Pro Forma

Patient Data from Referral Pro Forma			
Age (in years)			
Weight (in kilogrammes)			
Sex (M/F)			
Ethnicity	White	<input type="checkbox"/>	
	Black	<input type="checkbox"/>	
	Asian	<input type="checkbox"/>	
	Other	<input type="checkbox"/>	
Referral Hospital			
Primary Diagnosis			
Co-Morbidities			
Time and date of Intubation * (if known)	...../...../.....	hrs	mins
Time and date of Referral	...../...../.....	hrs	mins
Blood Gas Values on Referral			
Haemoglobin (mmHg)			
PH			
PaO ₂ (kpa)			
PaCO ₂ (kpa)			
FiO ₂ (percent)			
Lactate			
Mean Arterial Blood Pressure (MABP) mmHg			
Adrenaline (if present) mcgs/kg/minute			
Noradrenaline (if present) mcgs/kg/minute			
Additional data			
Advice given to referring hospital (free text) (use continuation sheet if required)			
Mode of Transport	Road <input type="checkbox"/>	Helicopter <input type="checkbox"/>	Fixed Wing <input type="checkbox"/>
Mode of Retrieval	Mobile <input type="checkbox"/>	Conventional <input type="checkbox"/>	

Note: * check patient records if not known/documentated on referral pro forma

2.Transport Log

Transport Log Timings		
Time of journey started from base (24-hour clock)	hours	minutes
Time of arrival at referring hospital	hours	minutes
Time spent at the referring hospital	hours	minutes
Time commencing return journey	hours	minutes
Time of arrival back to base	hours	minutes
Any untoward incidents affecting the journey timings either: patient related- e.g. cardiac arrest, deterioration or transport related e.g. vehicle breakdown, road closure	Patient related:	Transport related:
Patient Data: Blood Gas Values on Arrival		
Haemoglobin (mmHg)		
PH		
PaO ₂ (kpa)		
PaCO ₂ (kpa)		
FiO ₂ (percent)		
Lactate		
Mean Arterial Blood Pressure (MABP) mmHg		
Adrenaline (if present) mcgs/kg/minute		
Noradrenaline (if present) mcgs/kg/minute		
Interventions carried out at referring hospital – please denote type, number, and indicate Yes/No	Crystalloid	1 2 3 4
	Colloid	1 2 3 4
	Blood	1 2 3 4
	Bicarbonate	1 2 3 4
	Frusemide (in mgs)	
	Insertion of Ng Tube Y/N	
	Insertion of Venous access Y/N	
	Insertion of Arterial access Y/N	
	Insertion of chest drain Y/N	
	Adrenaline commenced/increased Y/N	
	Noradrenaline commenced/increased Y/N	
	Nitric commenced Y/N	
	Amiodarone commenced/increased Y/N	
	Any other drugs given – please write	

	Cardiopulmonary resuscitation Y/N	
Any other interventions not listed but undertaken at referring hospital (please write)	Interventions:	
Interventions undertaken by the transport nurse in transit		
Please denote type, number, and indicate Yes/No	Crystalloid	1 2 3 4
	Colloid	1 2 3 4
	Blood	1 2 3 4
	Bicarbonate	1 2 3 4
	Frusemide (in mgs)	
	Insertion of Ng Tube	Y/N
	Insertion of Venous access	Y/N
	Insertion of Arterial access	Y/N
	Insertion of chest drain	Y/N
	Adrenaline commenced/increased	Y/N
	Noradrenaline commenced/increased	Y/N
	Nitric commenced	Y/N
	Amiodarone commenced/increased	Y/N
	Any other drugs given – please write	
	Cardiopulmonary resuscitation	Y/N
Increase/decrease in FiO ₂	Y/N	
Increase/decrease in sedation	Y/N	
Any incidents or untoward events during transport (free text)	Events/Incidents	

Action taken by transport nurses in dealing with incidents/untoward events (free text)	Actions taken
Impact of these events on patient stability e.g. patient deterioration	Yes <input type="checkbox"/> No <input type="checkbox"/>

3. ECMO Documentation

Pre ECMO Patient Data			
Blood Gas Values immediately Pre ECMO			
Haemoglobin (mmHg)			
PH			
PaO ₂ (kpa)			
PaCO ₂ (kpa)			
FiO ₂ (percent)			
Lactate			
Mean Arterial Blood Pressure (MABP) mmHg			
Adrenaline (if present) mcgs/kg/minute			
Noradrenaline (if present) mcgs/kg/minute			
Time and date of ECMO commencement (24-hour clock)	...../...../.....	hrs	mins
Time and date of ECMO decannulation (24-hour clock)	...../...../.....	hrs	mins
Number of hours on ECMO			
Date and time of patient discharge	...../...../.....	hrs	mins
Location of where patient discharged to			
Type of location	ICU <input type="checkbox"/>	Ward <input type="checkbox"/>	
	Home <input type="checkbox"/>	Other <input type="checkbox"/>	

4. Patient's Medical Records

Please note there are 4 pages of the Data Collection Tool to complete. Any omissions may affect data validity. Please check the patient's medical records for any data items not completed.

Enter any free text in the continuation sheet provided.

5.Continuation Sheet.

APPENDIX 10. ETHICAL APPROVAL

UHL 11350

RESEARCH AGREEMENT

University Hospitals of Leicester NHS Trust, Trust Headquarters, Level 3 Balmoral Building, Infirmary Square, Leicester Royal Infirmary, Leicester LE1 5WW ("**Leicester**")

and

De Montfort University of The Gateway, Leicester LE1 9BH ("Sponsor")

Re: Optimising Patients for Referral and Transfer to Extra Corporeal Membrane Oxygenation (ECMO)

Chief Investigator: Lynn Deakin

The purpose of this agreement is to formalise the rights and obligations of each party including responsibilities for complying with applicable legislation.

RESEARCH GOVERNANCE TERMS AND CONDITIONS

By signing this agreement the Parties agree the following:-

1. *Obligations*

- 1.1 The Parties shall comply with all laws and statutes relevant to the conduct of the Project including the Human Rights Act 1998 and the Data Protection Act 1998, and with all relevant guidance including the ICH Guidelines on Good Clinical Practice, the NHS Research Governance Framework for Health and Social Care of April 2005 and the Medicines for Human Use (Clinical Trials) Regulations 2004, as amended from time to time.
- 1.2 The Sponsor's sole obligation under this agreement shall be to provide the services of De Montfort University (the "Supervisor") to supervise the activities of the Chief Investigator in conducting the Project in accordance with a project protocol approved by the Sponsor. The Sponsor undertakes to perform this obligation using reasonable care and skill. All warranties and undertakings not expressly set out in this agreement are hereby excluded to the fullest extent permitted by law.
- 1.3 Except as otherwise expressly set out in clause 1.2, Leicester shall be responsible for the performance of all parts of the Project.
- 1.4 Leicester has copies of the following: a copy of the proposed informed consent form including electronic recruitment pack; a copy of the Chief Investigators CV; a copy of the application to the relevant Research Ethics Committee and ethics approval letter.
- 1.5 The Parties shall conduct the Research in accordance with:
 - the protocol including any amendments approved by the Sponsor;
 - the terms and conditions of the approval of the relevant Ethics Committee(s); and
 - the terms and conditions of the approval of the relevant NHS Trust(s)
- 1.6 Leicester shall ensure that no research subject shall be recruited into the Project at the site of the Project until it is satisfied that all relevant ethics committee and NHS trust approvals have been obtained. Leicester shall ensure that all such consents and approvals are maintained throughout the term of the Project.

14th May 2014

To whom it may concern

RE: De Montfort University Ethical Approval: Optimising Patients for Referral and Transfer to Extra Corporeal Membrane Oxygenation (ECMO). A Mixed Methods Approach: Qualitative Phase (DMU ref: 1191)

This is to confirm that De Montfort University is undertaking the responsibilities of Sponsor with regards to the above project, as outlined in the Department of Health Research Governance Framework (2005). Once a project is approved by De Montfort University's Research Ethics Committee, on the understanding that the protocol agreed by this institution is the same as that approved by the NHS ethics committee, it will be covered by the University's insurance. Providing that there is no deviation from the project specification approved by the University Ethics Committee I confirm that the University's Standard indemnity insurance will be provided.

We hereby confirm that we have in place a public liability and an employers' liability policy which covers our legal liabilities in respect of negligent acts or omissions which result in bodily injury to third parties and employees and/or third party property damage'. Cover applies in respect of this project but there is no provision for payment of "no fault compensation". Cover is otherwise subject to insurer's standard terms and conditions. The policy does not apply to medical treatment risks.

The project: 'Optimising Patients for Referral and Transfer to Extra Corporeal Membrane Oxygenation (ECMO). A Mixed Methods Approach: Qualitative Phase' managed by Susan Lyn Deakin, under supervision by members of staff from the Faculty has had ethical approval granted from the Faculty Ethics Committee. In addition, as part of the ethical process this project has also undergone independent academic scrutiny to ensure that the study content and design is appropriate to both the stated aims and objectives and to the level of study.

Should you have any questions regarding this, please do not hesitate to contact me.

Yours sincerely,



Professor Martin Grootveld
Chair
Faculty Research Ethics Committee
Faculty of Health & Life Sciences
De Montfort University

Email: hlsfro@dmu.ac.uk

Web: <http://www.dmu.ac.uk/research/ethics-and-governance/faculty-specific-procedures/health-and-life-sciences-ethics-procedures.aspx>

APPENDIX 11. EXAMPLE OF MEMO.

MEMO 57: Technology 4.

I was particularly struck by the quote;
'Its like a computer going on in your head'

My initial thoughts were : Yes! That's what Benner was meaning, using all our phronesis, practical wisdom, mentally preparing for the patient and translating this into action. But then another thought, my mum was a nurse, Benner was a nurse, and reading 'Novice to Expert' this was an unusual phrase – in that time and date. That's the difference then, computer and technical speak has now entered into our everyday language. So is the explanation then really that simple? – were we saying the same as previous generations of nursing but just using a different jargon?

Further thoughts to the future of nursing, a human body in a nurses uniform, but with a piece of software instead of grey cells came to mind. Can computers or machines in future replace nurses just like robots and car manufacturers? Will there be a marginalisation of nurses through perpetuation of technology?

Back to the debates surrounding technology and nursing v care and nursing. A debate that seems to my mind to be a never ending circle. In order to carry out the nursing role in ITU, technology is vital, but is technology really an obstruction, a barrier or is there a symbiosis, an entwinement, within which the role of the ITU 'nurse' is not only identified but also functions.

To do: go back to transcripts to explore this idea further, read more into technology and nursing , and theories of nursing.

MEMO 102: Technology 9

Exploring further transcripts regarding the prior memo, I came across;
' they are no longer ECMOable'

The application of ECMO , the importance of technology, or artifact, its prominence demonstrated to the point of everyday language of the transport nurse. The assimilation of thoughts and actions that are translated into words, the external representation of the internal process. So, present in the mind of the transport nurse , indeed ingrained in their thought processes, is the journey of technology and their role side by side.

Do they battle for supremacy? The Technology Acceptance models seems to favour technology as omnipresent, or as Bagozzi points out the possibility of social determination of humans exerting power over human-technology relationships.

From the transcripts it does not appear that either side is co-erced by each other, have read them again with this thought in mind and it appears to be a symbiotic if not fruitful and efficient

relationship. However, this does only apply to the transport nurses, from their thoughts, it appears that not all nurses exhibit this quality.

Further reading into this new world view for me, takes me to the 'sociotechnical lens', which thank goodness has also been used in nursing! I need a theory that accounts for this neutrality and harmony. At length I come across the Actor-Network Theory, deciphered through a somewhat rusty history of sociology. It not only accedes equality of power but is pragmatic and allows you to follow the steps through to reach a common aim. It appeals also on the non technology side, as a way of viewing how networks assemble, disassemble, and reassemble. This is exactly what a transport team does undertaking a transport journey.

To Do: Try and apply the theory to the journey of the transport nurses, not only to explain their interaction with non humans but also with those of humans. Using the steps in the theory to try and follow them on their journey and take account of this assembling and recruiting in order to help the patient as much as possible (humanely and non humanely!)

Will this answer the debate about technology and nursing?

APPENDIX 12 PARTICIPANT INFORMATION SHEET AND CONSENT FORM.

Information Sheet for Research Participants

(Interviews)

Study title: Optimizing Patients for Referral and Transfer to Extra Corporeal Membrane Oxygenation (ECMO).

You are being invited to take part in a research study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully, feel free to ask if there is anything that is not clear or if you would like more information, and then decide whether or not you wish to take part.

What is the study about?

Much has been written about transport of acutely ill patients, but few studies have considered the optimum management of patients prior to transport, and there is a lack of evidence to indicate what actually happens in the base Intensive Care Unit whilst waiting for transport, the communication involved, and the involvement of the nursing staff. This is a qualitative study exploring the thoughts, feelings and perceptions of those nurses directly concerned with the patient whilst waiting for the transport team. The information provided will be used to influence future preparation of patients in terms of communication and strategies, such as guidelines to optimise the patient for transport and/or initiation of the mobile ECMO team.

Why have I been chosen?

You have invited to take part in this research project, having been identified by the ECMO Co-ordinator as being the named transport nurse for the patient at the time of the referral, and you have shown an interest and willingness to take part after discussion with the transport team and the researcher.

Who is involved in the study?

The study is being carried out by Susan Lyn Deakin: Senior ECMO Specialist, employed by University Hospital of Leicester and a DHSci student at De Montfort University at Leicester. She is supervised by Dr Peter Norrie at De Montfort University.

Do I have to take part?

No, the study is entirely voluntary. If you decide to take part you are still free to withdraw at any time, without giving a reason.

What will happen to me if I take part?

If you are willing to take part in the study you will be asked to phone Susan and she will make an appointment to speak to you, over the telephone, at a time convenient for you. She would like about 20 - 30 minutes of your time, to ask you some questions about your thoughts, feelings and perceptions whilst getting the patient ready for transport. She will make notes and, if acceptable to you, will record the interview.

What happens to the information?

The information you give will be treated confidentially. No personal information will be used. The notes and recordings will be transcribed and all relevant content analysed. You will be given a summary of the main points of the interview by registered post, and asked to return it in a pre posted envelope, if you agree and confirm the contents. Any queries or concerns about the summary can be discussed by contacting Susan by telephone. The data will be kept in a locked office at the University on a password protected computer and only the researcher will be able to see it. At the end of the study all records will be kept in a secure environment within a central repository at the University.

What are the possible benefits of taking part?

The results will be used to inform the ECMO service of how they can optimise the patient prior to transport. Findings may be used to produce guidelines or flowcharts for the referring hospital and staff to follow. In addition it may identify any training issues that need addressing.

What if I wish to complain?

You are welcome to raise any difficulties or concerns with Dr. Peter Norrie on 0116 201 3914 (9-5 weekdays), or you can use email: pnorrie@dmu.ac.uk.

Should you wish to complain about the conduct of the research, this should be addressed to Mrs North Rose, Head of the School of Nursing and Midwifery, DMU (0116 201 3878)

What will happen to the results of the study?

The results will be made available following the completion of the study in December 2014. Initial findings will be presented to the School of Nursing and Midwifery and publication may be sought. If so, a draft of the report will be circulated to all participants for comment.

Will my taking part in this study be kept confidential?

The information you give will be treated confidentially. No personal information will be used. The notes will be transcribed and all comments analysed together to give us a picture of the needs of the profession and service. If you decline to take part, your decision will be not be communicated to anyone.

Who is organising and funding the study?

The study is organised, and funded by Susan Lyn Deakin, a Senior ECMO Specialist in the University of Hospitals of Leicester NHS Trust, and a part time student of the DHSci programme at the Faculty of Health and Life Sciences at De Montfort University, Leicester.

Who has reviewed the study?

The study has been reviewed by De Montfort University Health and Life Sciences Faculty Research Ethics Committee, and The University Hospitals of Leicester and the study has been given a favourable opinion.

Susan Lyn Deakin has received written affirmation from the University Hospitals of Leicester (UHL) and has written to your Trust Research and Development Department, who have raised no objections. You will be shown written evidence of this, if you wish.

Contact for further information

If you would like any further information, or any clarification regarding the study or need to ask any questions please contact Susan Lyn Deakin on xxxxxxxxxxxxxx

Thank you for taking the time to read this information sheet. We are very grateful for your participation in this study.

You will be given a copy of this information sheet and a copy of the signed consent form to keep.

S.L. Deakin RGN, BSc (Hons) MSc.

CONSENT FORM

Title of Study; Optimizing Patients for Referral and Transfer to Extra Corporeal Membrane Oxygenation (ECMO).

Name of Researcher: Susan Lyn Deakin

Please insert your
initials

Interviews to be carried out by Susan Lyn Deakin

I confirm that I have read and understand the information sheet dated :25/07/2013 for the above study and have had the opportunity to ask questions

[]

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without any consequence or this information being communicated to anyone

[]

I agree to take part in the above study

[]

I agree to the investigator making notes during the interview and understand that when a report is drafted my name will not appear.

[]

[]

I agree to the interview being recorded

I agree that things I say during the interview may be used, but these will not be attributable to me personally.

[]

I understand that I will have the opportunity to review the draft report and make comments to the researcher.

[]

I understand that sections of my data collected during the study may be looked at by individuals from De Montfort University, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to these data.

[]

Name of participant:

Signature of participant:

Date:

Date

Name of witness:

Signature of witness:

APPENDIX 13. ADVICE GIVEN TO REFERRING HOSPITALS.

1	Get fluid off by increasing Frusemide infusion to 20mg/hr, start tamiflu if fibrinogen raised
2	Advised to wait and see, try and oscillate half hourly, advised proning - little effect- also tried Nitric - made no difference to Po2, so accepted for mobile ecmo
4	Start CVVH and give 2 units of blood- did start cvvh On referral Hb 8.8 on arrival Hb 11.8
5	Accepted for ECMO - acute deterioration -try and organise novolung whilst awaiting transport team, did commence HFOV, added in adrenaline, not able to get novolung so mobile
6	Start cvvh to get fluid off overnight and review - did do this - only 2.2 litres positive by time team arrived (was 5.0) , added in Adrenaline
8	Put chest drain on low flow suction
9	Further clarification and ct chest
13	Advised to check SVC patency with USS - did, required inotropes whilst awaiting transport team
14	Try and get CT of chest and abdomen, as also acute abdo ?splinting - unable to do as pt too unstable, uss scan done of rij with transport team there
18	Advised to give gentamycin and fluid - however deteriorated - so mobile
19	Start cvvh and bring potassium down - did
22	Increase fluid removal on cvvh, prone, try adrenaline,as peripheries dusky, try and put onto conventional for transfer as currently on hfov.- put on conventional, did put adrenaline on
26	Advised to repeat cxray and give 2 units of blood -
27	Manage fluid balance - did but deteriorated further
28	No beds at Glenfield overnight - high CO2 problem as pO2 ok - advised to try and get novolung - not able to
30	Continue with current management, give frusemide, still overloaded
32	Dry out 12 litres overloaded on referral, 9 litres on arrival, no cvvh , no frusemide infusion , still 7 litres
38	Start cvvh, get a negative fluid balance , positive 6 litres,consider hfov , repeat cxray, and do an echo as went into af,, no bed at present, Did start cvvh, still positive , awaiting echo
41	Increase haemoglobin pre 8.0 on arrival 11.0
42	Advice ; pyrexial at 40.1 for active cooling, increase Hb and prone,: given 2 units of blood, positive 8 litres, no active cooling blanket, we did explore their sister hospital providing one, in not suggest transfer of pt, unable to get either, put on cvvh to offload and cool, deteriorated - mobile ECMO
43	Increase inotropes, do cxray, put in chest drain
44	Do an h1n1 test, start frusemide infusion, , 12 l positive, on novolung, no cvvh, chest drain inserted , frusemide infusion 250/50 at 2 mls/hr

APPENDIX 14. INTERVENTIONS ON JOURNEY BACK

	MODE	ACTION BY TRANSPORT TEAM
1	MOBILE	Volume given for decreased flows to the ECMO circuit
2	MOBILE	Problem with CVP line in ambulance, inotropes not working , put onto ECMO circuit and CVP repositioned and resutured in ambulance – still having problems however, changed sedation as Alfentanyl ran out but Propofol in transport bag
3	MOBILE	Inotropes weaned . Increased sedation. 2 units blood given by transport team
5	MOBILE	Sodium Bicarbonate given during transport as acidotic
6	CONVENTIONAL	Bicarbonate 8.4% given, weaned Noradrenaline infusion
7	MOBILE	Calcium and Sodium Bicarbonate x 2 given
8	CONVENTIONAL	Noradrenaline weaned during transfer
9	CONVENTIONAL	Noradrenaline weaned during transfer from 12 ↓10 ↓9 mls/hr
10	CONVENTIONAL	Volplex 500 mls given , and Sodium Bicarbonate given
11	MOBILE	Sodium Bicarbonate given, Noradrenaline ↑ on way back
12	CONVENTIONAL	Arrhythmic in flight , nothing given, but settled on landing
13	MOBILE	Given Sodium Bicarbonate x 300 mls , Noradrenaline weaned during transfer
14	MOBILE	Given Volplex in ambulance, Noradrenaline weaned from 7 mls to 3 mls , Sodium Bicarbonate given
15	MOBILE	Unable to get ABP working on monitor so arterial line connected to ECMO transducer to gain a reading . Given sodium Bicarbonate to correct acidosis and 2 units of blood , Noradrenaline weaned from 26 mls to 12 mls on way back
17	MOBILE	Sodium Bicarbonate 200 mls, 10% Glucose, 1 unit of blood
19	CONVENTIONAL	Able to wean FiO2 in ambulance

20	MOBILE	Kink in CVP line temporarily occluded inotrope flow - bolus given of both and 500 mls volplex
21	CONVENTIONAL	Sodium Bicarbonate given for acidosis 2 x 100 mls in ambulance, 2 units of blood given in ambulance, Adrenaline increased, Noradrenaline decreased during journey , no response to nitric which was tried prior to getting in ambulance, sats not reading due to vasoconstriction, but istat working ok
24	CONVENTIONAL	Sodium Bicarbonate x 2 of 100 mls given during journey and Hartmanns
25	CONVENTIONAL	Vasopressin increased during ambulance journey as BP sagged, Noradrenaline decreased and Adrenaline decreased during transport
26	CONVENTIONAL	Noradrenaline weaned on journey back.
29	CONVENTIONAL	Decrease in sats after lying down for transfer to helicopter - recovered after 20 mins
30	MOBILE	Started Adrenaline infusion, Given frusemide bolus
32	CONVENTIONAL	2 units of blood given during transfer
33.	CONVENTIONAL	Uneventful sats 80% throughout the journey
34	CONVENTIONAL	In atrial flutter blood x 1 given, and frusemide 40mg, 2nd unit blood given, Adrenaline infusion commenced and increased and Bolus given , all during journey
36	CONVENTIONAL	Hyperpyrexial - heating turned off in ambulance and patient exposed, BP dropped, 500mls Volplex given
37	CONVENTIONAL	Peripheral oxygen saturations 70% throughout
38	CONVENTIONAL	BP sagged during journey but due to CVP needing repositioning in ambulance - stitch undone and repositioned
39	CONVENTIONAL	Helicopter broke down so had to go by road
40	CONVENTIONAL	Sedation, and atracurium increased during transfer
41	CONVENTIONAL	Noradrenaline infusion increased during journey
42	CONVENTIONAL	40 mmol potassium given , heating turned down in ambulance and patient exposed
43	CONVENTIONAL	Noradrenaline weaned off, Nitric 20ppm commenced

46	CONVENTIONAL	Blood x 2 given in ambulance, and extra sedation
47	CONVENTIONAL	Noradrenaline weaned during journey, Fio2 decreased as PaO2 22 on istat
48	CONVENTIONAL	Noradrenaline increased during journey
49	CONVENTIONAL – MOBILE	Calcium given during journey
50	CONVENTIONAL	Noradrenaline weaned off during journey.

